# National Oceanic and Atmospheric Administration

# NOAA Research Scientific Computing Support
(*Exhibit 300 UPI Code: 006-48-01-13-01-3504-00)*

# Operational Analysis

# October 2007 – September 2008 (FY08)

**Table of Contents**

**Executive Summary**

**NOAA Research Mission Statement**

*To conduct research, develop products, and provide scientific information and leadership to foster NOAA's evolving environmental and economic mission.*

***NOAA Research Vision Statement***

*Societally relevant research that forms the scientific basis for more productive and harmonious relationships between humans and their environment.*

NOAA Research activities contribute to NOAA's mission goals to:

- *Protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management,*
- *Understand climate variability and change to enhance society's ability to plan and respond,*
- *Serve society's needs for weather and water information, and*
- *Support the Nation's commerce with information for safe, efficient, and environmentally sound transportation.*

NOAA's research, conducted through the Office of Oceanic and Atmospheric Research (OAR), is the driving force behind NOAA environmental products and services that protect life and property and promote sustainable economic growth. Research, conducted by programs within NOAA and through collaborations outside NOAA, focuses on enhancing our understanding of environmental phenomena such as tornadoes, hurricanes, climate variability, changes in the ozone layer, El Niño/La Niña events, fisheries productivity, ocean currents, deep sea thermal vents, and coastal ecosystem health. NOAA research also develops innovative technologies and observing systems. The NOAA Research network consists of internal Research Laboratories, programs for Undersea Research and Ocean Exploration, a grants program through the Climate Program Office, external research at Sea Grant universities and programs, and Cooperative Joint Institutes with academia. Through NOAA and its academic partners, thousands of scientists, engineers, technicians, and graduate students participate in furthering our knowledge of natural phenomena that affect the lives of us all.

NOAA and the nation depend on the cutting-edge science provided by its research programs. Recently, NOAA Research built much of the foundation for the modernization of the National Weather Service. The research programs provide the sound science necessary to help NOAA achieve her goals to:

- serve society's needs for weather and water information;
- lead the effort to understand and monitor climate variability and change to enhance society's ability to plan and respond;
- work to protect, restore and manage the use of coastal and ocean resources through ecosystem-based management; and
- support the Nation's commerce with information for safe, efficient and environmentally sound transportation.

Working under the broad themes of Climate, Weather and Air Quality, and Ocean and Coastal Resources, NOAA scientists study the ocean's depths and the highest reaches of space to better understand our environment. NOAA's long-term commitment to the highest quality research includes engaging in-house and extramural talent to:

- continue to conduct experiments to understand natural processes (physical, geochemical, ecological);
- build predictive models for use in weather, climate, solar, ocean, and coastal assessments and predictions;

- develop and deploy new observing technologies to provide data to support predictive models and to document natural variability;
- develop new analytical and forecast tools to improve weather services;
- use new information technology to share information with other federal and academic scientists; and
- prepare scientific assessments and information products to enhance public education and guide governmental action.

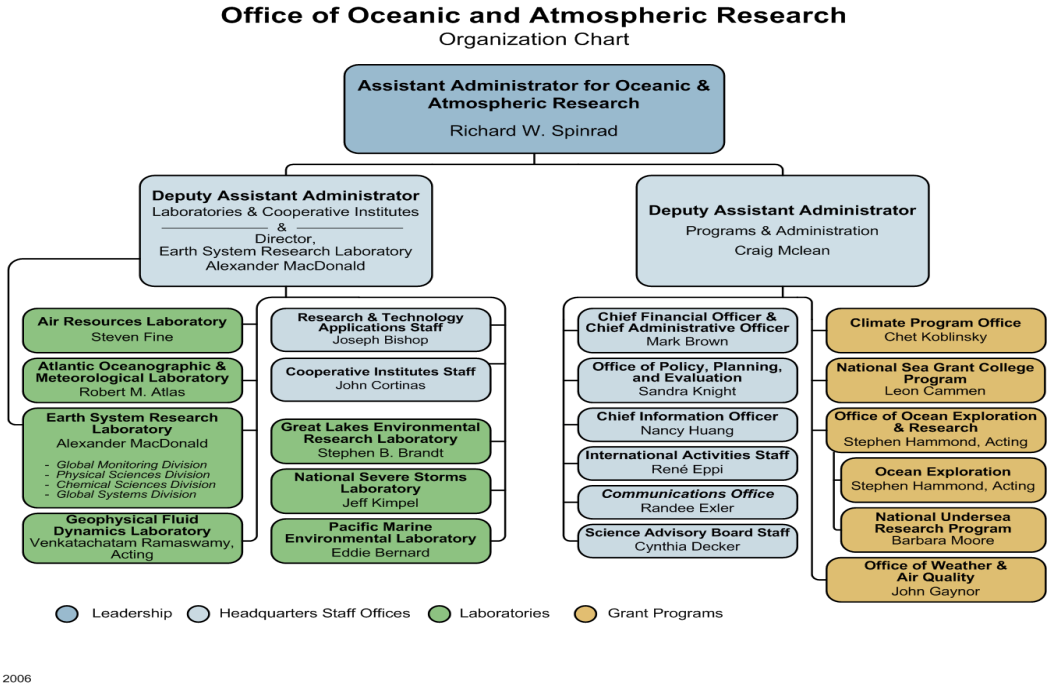
Research plans and products are developed in partnership with academia and other federal agencies, and are peer-reviewed and widely distributed. A high premium is placed on external collaboration both domestically and internationally. In addition, personnel management practices of hiring, promotion, and awards are based on demonstrable capability through internal and external peer assessment. Peer review, collaboration, and partnerships ensure that NOAA's research is of the highest quality and remains focused on critical issues.

Most of the environmental questions our nation and the world face are not easily answered. A strong NOAA is necessary to tackle the complex issues that only advanced scientific knowledge is able to adequately address. NOAA Research answers the call and:

- provides comprehensive knowledge to guide national environmental policy decisions, including better predictions of the climate response to emissions changes, choices for protection of the ozone layer, and alternatives for developing coastal communities;
- improves environmental services to the nation, including reliable predictions and assessments; and
- promotes economic growth through science for decision-making, new technology, and partnerships with academia and industry;

NOAA is a world leader in environmental science today and is well positioned and organized to provide the sound scientific research policy-makers will always need.

Appendix A provides a brief summary of the science performed by each Laboratory within NOAA Research..



## 1.0 Customer Results

### 1.1 Customer Requirements and Costs

NOAA's research serves diverse customers. The average citizen benefits through earlier warnings of threatening weather, healthier coasts and fisheries, or a broader understanding of environmental processes. The private sector uses NOAA data to make business decisions and also employs technology developed and transferred by NOAA scientists. Federal agencies, state governments, and local authorities rely on NOAA research expertise for the sound scientific basis of crucial policy decisions related to environmental protection and restoration strategies. NOAA researchers are recognized as international leaders on environmental issues. With their international counterparts, NOAA scientists contribute to the understanding and assessment of issues such as ozone depletion and climate variability which must be addressed worldwide to ensure success.

The scientific computing needed to support NOAA's research is a steady state investment. It is critical to provide an infrastructure that delivers Program products and services using information technology solutions that meet the needs of the science and the scientists.

IT Technical refresh is performed based on established industry practices, routinely on a 3 year cycle for desktops, and 4 years for server systems and communications equipment due to the higher cost. NOAA Research desktop operating systems include Windows, Macintosh, and various distributions of Linux. According to Gartner (**Use Processes and Tools to Reduce TCO for PCs, 2005-2006 Update, 13 January 2006**), PC hardware and operating system choices are no longer the greatest determinants of PC total cost of ownership (TCO). The implementation of policies, best practices and processes offers the main opportunities for enterprises to reduce the TCO of their PC installed base across its life cycle.

Very loosely coupled clusters can be created by combining together otherwise idle desktop computers in an ad-hoc environment, thus allowing a dual use of certain resources. Such clusters allow researchers to use otherwise "wasted cycles" by combining computer resources that would be idle overnight to tackle specific jobs. In particular, ESRL has been running a loose cluster of 60 Macintosh desktop computers for the past few years which is managed as a desktop system and as a node in a loose cluster.

Environmental modeling applications are processor intensive, and when compute systems are replaced, compute cluster technology is purchased to ensure scalability and load balancing. A compute cluster is a group of loosely coupled computers that work together closely so that in many respects they can be viewed as though they are a single computer. The components of a cluster are commonly, but not always, connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability. Cost efficiencies can be achieved because a cluster does not have to be replaced when more processor power is needed – instead, it can grow by acquiring additional processors.

### 1.2 Performance Measures

NOAA Research has an indirect but important role that can potentially impact lives and property. Below are selective highlights from FY2008 project accomplishments that demonstrate performance results to the citizens of the US. These measures align with the "Customer Results Measurement Area" of the Performance Reference Model developed by the Federal Enterprise Architecture Program Management Office (FEA-PMO). Table 1 summarizes the performance measures.

**Table 1: Customer Results Performance Measure**

| Measurement Area | Indicator | [Reporting Year – 1] Baseline | [Reporting Year] Actual Result | Comments |
|---|---|---|---|---|
| Customer Requirements | Climate Observation and Analysis: Integrated Ocean Observing System (IOOS) Implemented | 59% | 59% | |

NOAA research and development is unique within the federal government. No other agency investigates the Earth system from the bottom of the ocean to the top reaches of the atmosphere. NOAA researchers are tackling some of our Nation's most pressing challenges, including global climate change, improving weather and air quality forecasts and warnings, understanding the complexities of the oceans, and natural resource management. Here are some prime examples of NOAA Research (Scientific Computing Support) accomplishments in 2008.

NOAA-Developed Technology Used to Assist Firefighters of California Wildfires
A meteorological workstation developed by NOAA's Earth System Research Laboratory (ESRL) is being used by National Weather Service Incident Meteorologists (IMETs) deployed to the devastating wildfires in California. Considered key members of the fire fighting team, IMETs are using the FX-Net system as their primary means of getting weather information to the fire Incident Commanders and emergency managers working on the fires. FX-Net offers forecasters' flexibility in manipulating the data to meet specific, localized needs. Forecasters can animation graphic and imagery data, overlay data sets to forecast localized weather as needed by firefighters, emergency managers, and others.

Higher-resolution Rapid Update Cycle Model
Earth System Research Laboratory (ESRL) researchers released the Rapid Update Cycle (RUC) weather analysis and forecast model data at higher horizontal and temporal resolutions for all NOAA data users. Moreover, RUC forecast data became available at hourly output increments out to 9-hours. NOAA's Aviation Weather Center and Storm Prediction Centers, forecast offices, Federal Aviation Administration, and private sector are users of analysis and forecast products from the RUC.

Bycatch days may be bygone with creation of 'Eliminator' trawl
A team of Rhode Island Sea Grant researchers were awarded the $30,000 grand prize in the World Wildlife Federation's International Smart Gear Competition for a net called The Eliminator. Cod and flounder are heavily restricted by federal fisheries regulations but often swim with haddock, and are caught together in commercial fishing trawlers. Fishermen then have to throw thousands of pounds of cod and flounder back into the ocean — where they will likely die — because they were caught alongside haddock. The Eliminator effectively solves this problem by taking advantage of haddock's tendency to swim up when faced with a net, when other fish swim down. The collaborative design and development of the Eliminator trawl is a great example of industry and scientists working together with managers to develop innovative solutions to reduce or eliminate bycatch.

NOAA installs its 3000th Argo Buoy and achieves its goal of reducing temperature measurement error
NOAA researchers including those at NOAA's Joint Institute for Marine Observations (JIMO) met the goal of deploying and maintaining three thousand Argo floats in active service. The Argo array of profiling floats provides essential broad-scale, basin-wide monitoring of the upper ocean heat content. The heat content of the upper 2000 meters of the world's oceans, and the transfer of that heat to and from the atmosphere, are variables central to the climate system. Global sea level change is directly related to the ocean's heat content – as the ocean's temperature rises the water expands and thus sea level rises. The Argo array provides measurements needed to 1) document heat uptake, transport, and release by the ocean; 2) document global sea level change, and 3) document the air-sea exchange of heat and water and the ocean's overturning circulation. While prior oceanic data collection relied heavily upon research

vessels with limited timetables and ranges, the Argo network has made it possible for scientists to gather real-time, evolving data around the clock and around the world. The Argo float network provides an average coverage of one sensor for every three degrees of latitude and longitude. Such coverage is necessary to understand the complex interplay between the components of the world's air-sea-land climate system. Some climate scientists have posited that the oceans have absorbed more than 80 percent of the excess heat generated by global warming over the past 50 years, though they have lacked observational data needed to verify such claims. With the completion of the Argo network, scientists will now have the ability to test such hypotheses and substantially advance the study of oceans and their role in climate.

Report Warns of Lake Erie Water Levels Plunging as Temperatures Rise

Lake Erie water levels could drop between 3.28 and 6.56 feet by 2066 as the climate in the region warms according to a three-year study funded in part by NOAA's Michigan Sea Grant program released in late 2007. The study of the Detroit River-western Lake Erie corridor, entitled "State of the Strait: Status and Trends of Key Indicators 2007," involved 75 scientists from nearly 50 government, business, academic, and public-interest groups, and utilized data and analyses from NOAA's Great Lakes Environmental Research Laboratory. The report cites the 2007 report of the U.N. Intergovernmental Panel on Climate Change, in which a consensus of scientists worldwide agreed that human activity is contributing to warming observed in the Earth's climate. Taking the midpoint of the report's prediction, a 4.92-foot drop would result in a four-percent reduction in surface area of the western basin and a 20-percent reduction in its volume. As the lake shrinks, western Lake Erie's shoreline could expand by nearly 4 miles potentially harming the shipping industry and compromising facilities communities use to treat water.

NOAA Scientists Show Ocean Warming Linked to Wind Shear and Fewer Hurricanes

An article by scientists of NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) and the Cooperative Institute for Marine and Atmospheric Studies (CIMAS) on global warming and Atlantic hurricane activity published in *Geophysical Research Letters* reports that global warming of the sea surface is associated with an increase of vertical wind shear in the main development region (MDR) for Atlantic hurricanes. The increased vertical wind shear coincides with a downward trend in U.S. landfalling hurricanes. NOAA's research into sea surface warming, wind shear, and hurricane formation is helping to answer questions about climate change and hurricanes that policy makers, emergency managers and affected populations have been asking. This work serves NOAA's goal to increase understanding of climate change to enhance society's ability to respond.

Autonomous Underwater Vehicles Investigate Bonaire Coral Reef Health

A NOAA-sponsored expedition investigated shallow and deep coral ecosystems off the Caribbean island of Bonaire to help identify why these coral reefs appeared to remain relatively healthy while many in the Caribbean and around the world are threatened. Scientists were surprised to find that corals in mid-waters were not as pristine as they had expected. The mission was one of the first in the International Year of the Reef 2008. In shallower waters, the team measured changes from limited surveys in the 80's and 90's. In deeper waters, three robots called Autonomous Underwater Vehicles (AUVs), surveyed the "Twilight Zone," 65 to 150 meters deep, where sunlight is scarce and little is known about reef systems. AUVs obtain wide-area data, allowing scientists to pinpoint further investigation."

NOAA Studies Atmospheric Mercury for Gulf of Mexico

Researchers from NOAA's Air Resources Laboratory (ARL) completed installation of ambient air mercury monitoring equipment at a permanent site within the Grand Bay National Estuarine Research Reserve (NERR), in Moss Point, Mississippi. This constitutes one of the first such stations in an emerging multi-agency national mercury network. Mercury is a powerful neurological toxin that accumulates in fish and is consumed by people. Long-term measurements provide essential information needed to better quantify atmospheric loadings to local watersheds, discern natural versus anthropogenic sources of mercury, and elucidate source-receptor relationships from known or suspected emission sources. The collected data will facilitate a more thorough evaluation of NOAA's mercury models. These models are key to establishing clear linkages between atmospheric processes (emission, atmospheric chemistry, deposition) and aquatic and biochemical processes that govern the incorporation and migration of mercury through the food web.

Scientists deploy new tool to monitor Solomon Sea
NOAA Researchers deployed a new instrument, called the "Spray Glider", to measure the currents and temperatures in the Solomon Sea, near Papua New Guinea. The Spray Glider is a 2-meter long tube with wings that is remote-controlled by satellite communication. It moves through the ocean, making a series of dives to 600 meters depth, reporting the northward flow through the Solomon Sea, one of the major currents of the world ocean. Variations of this current might be a key to the prediction of the El Niño climate oscillation. After three months, the glider returned to be picked up, refurbished, and redeployed.

NOAA Researchers awarded patent for DART buoy
NOAA Pacific Marine Environmental Laboratory (PMEL) researchers were awarded U.S. patent for the invention of the NOAA Deep ocean Assessment and Reporting of Tsunami (DART®) system. This system employs a seafloor tsunameter linked to an ocean surface buoy via bi-directional communication system for near real-time measurement and reporting of tsunamis. As the tsunami wave propagates across the ocean and reaches the DART® systems, these systems report sea level information measurements back to the Tsunami Warning Centers, where the information is processed to produce a new and more refined estimate of the tsunami source. The result is an increasingly accurate forecast of the tsunami that can be used to issue watches, warnings or evacuations (and avoid unnecessary evacuations).

For more detailed information on the DART system, see Appendix C below.

Ozone Hole Recovery Could Reshape Southern Hemisphere Climate Change
A full recovery of the stratospheric ozone hole could strongly modify climate change in the Southern Hemisphere and possibly amplify warming of the Antarctic continent, report scientists from NOAA's Earth System Research Laboratory and Cooperative Institute for Research in Environmental Sciences.
As ozone levels recover, the lower stratosphere over the polar region will absorb more ultraviolet radiation from the sun. As a result, intense westerly winds that block air masses from crossing into the continent's interior would weaken, and Antarctica would no longer be isolated from the warming patterns affecting the rest of the world. The influence of a full stratospheric ozone recovery on seasonal Southern Hemisphere climate will largely depend on how fast carbon dioxide and other greenhouse gases increase. While average surface temperatures have been rising globally, the interior surface of Antarctica has exhibited a unique cooling trend during the Southern Hemisphere summer and fall, resulting from stratospheric ozone depletion during spring. The Montreal Protocol restricted production of ozone-depleting substances, starting in 1987, and scientists predict the ozone hole will recover completely by 2070. Such changes in large-scale circulation patterns may ultimately have consequences for Australian and South American climate during late spring and summer. Australia could experience warmer and drier conditions, while areas in Argentina, Brazil, Uruguay, and Paraguay, could get wetter.

For more information on the ozone discovery, please visit:
http://www.esrl.noaa.gov/news/2008/ozonehole.html

NOAA Researchers Predict Fewer, but More Intense, Atlantic Hurricanes in the 21st Century
A new model simulation study of Atlantic hurricane activity for the late 21st century by scientists at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) published in *Nature Geoscience*, projects fewer hurricanes overall, but a slight increase in intensity for hurricanes that do occur. Hurricanes are also projected to have more intense rainfall, on average, in the future. Simulations reveal higher levels of wind shear and other changes projected to accompany 21st century global warming, acting to reduce the overall number of hurricanes in the model. This study employed a new regional model that offers both higher resolution and an improved ability--compared to current climate models--to simulate past observed changes in Atlantic hurricane activity. A limitation of this new model is its inability to reproduce the most intense hurricanes, given the under-prediction of major hurricane counts in its present-climate simulation. As a result, the model's projections of increased intensity and increased numbers of the most intense hurricanes with climate warming may be underestimates.

"On-Demand" Severe Storms Verification Support System

A new severe storm verification system was developed by National Severe Storm Laboratory (NSSL) researchers to help National Weather Service meteorologists quickly verify their severe thunderstorm and tornado warnings. The system is part of its Warning Decision Support System and is a suite of multiple radar/sensor severe weather decision assistance algorithms that run in real-time across the entire continental United States. Warning verification can be a time-intensive responsibility involving numerous phone call inquiries to the public, manual replay of single-radar data, and manual plotting and tracking of rotation in the thunderstorm often associated with tornadoes and severe weather, taking up to several hours. This product has the capability to reduce the preparation time for damage surveys by combining the geospatial data with a GIS or other mapping software such as Google Earth to quickly determine where the potential tornadic damage may have occurred. A high-resolution street map of potential damage areas can also be produced for surveyors and emergency responders. Improved verification efficiency will get surveyors into the effected areas sooner, before recovery and cleanup begins.

Study Finds Increasing Ocean Oxygen Depletion

A scientist from NOAA's Pacific Marine Environmental Laboratory co-authored an article published May 2 in *Science*, "Expanding Oxygen-Minimum Zones in the Tropical Oceans." The article reports on an analysis of ocean dissolved oxygen concentrations from the 1960s through the current decade in six study areas near or in the oxygen minimum zones (OMZ) of the tropical Atlantic, Pacific, and Indian Oceans. In the Atlantic, and to a lesser extent, the Pacific Oceans, these zones of low oxygen concentrations have become thicker as oxygen concentrations have decreased. The observations made in this study support climate model predictions of both declining dissolved oxygen in tropical oceans and expansion of the tropical OMZs as a result of increased temperatures. The term OMZ describes areas with the lowest concentrations of dissolved oxygen. While there are seasonal OMZs such as the dead zone off of the Louisiana coast, this study refers to year-round layers of low oxygen found at intermediate depths in tropical oceans. When oxygen concentrations become too low, commercially important organisms become stressed or die.

NOAA Researcher Named to Time Magazine's 100 Most Influential People

Dr. Susan Solomon, senior scientist at the ESRL Chemical Sciences Division, was named by *Time Magazine* as one of the world's 100 most influential people for 2008. She was one of 19 people named in the "Scientists and Thinkers" category of the listing. This is the fifth year that Time has published its list. The list spans politics, entertainment, the arts, science, business, and others. Each of the 100 is featured with a 1-page profile. Solomon's profile, written by IPCC Chair Rajendra Pachauri, mentions Solomon's scientific achievements related to the Antarctic ozone hole and her work as Co-Chair of the science working group of IPCC. The latter effort was recognized with the 2007 Nobel Peace Prize that was shared by the IPCC and former U.S. Vice President Albert Gore, Jr.

Improved Air Pollution Dispersion Model for NOAA Forecasters

Researchers at NOAA's Air Resources Laboratory (ARL) completed enhancements to the operational transport and dispersion model (Hybrid Single-Particle Lagrangian Integrated Trajectory (HySPLIT)) to allow for long-range dispersion beyond four days and for generating additional output graphical formats, such as that used by Google Earth. These new capabilities greatly enhance and support the NOAA's atmospheric dispersion forecasting capability. The HySPLIT detects hazardous atmospheric releases (such as from explosive volcanic eruptions and radiological releases) and provides fire smoke forecasts. NOAA weather forecasters develop dispersion forecasts in support of local emergency managers. Volcanic ash and radiological forecasts are provided under the auspices of the International Civil Aviation Organization and World Meteorological Organization and Regional Specialized Meteorological Center for Environmental Emergency Response. For the radiological application, long-range forecasts now will be used to help answer when and where radioactivity from an overseas incident will reach the U.S. and allows back-tracking capabilities for estimations of source areas when the source is unknown.

NOAA Implements Soil Moisture Observational Network

NOAA's Earth System Research Laboratory (ESRL) implemented a Soil Moisture Observational Network across southern Arizona's San Pedro River Basin, measuring soil moisture and temperature, and basic meteorological parameters at the surface (pressure, temperature, humidity and rainfall). ESRL, working with the Colorado River Basin Forecast Center and National Weather Service Office of Hydrologic

Development aims to improve flash flood forecasting and better understand how soil information (i.e. moisture, texture, and temperature) can be included in hydrologic models. Southern Arizona's San Pedro River recharges ground water storage and provides water for human needs and those of agriculture. However, during the North American monsoon season (July-September), heavy precipitation events can cause severe flooding in the San Pedro basin. Arizona's dry climate and a rapidly growing population increase the risk of impacts from flash floods and drought. Accurate soil information is needed to support flash flood forecasts and warnings and can be useful in water resource management studies.

Aviation Weather Tools Enhance Flight Safety and Efficiency

Aviation-specific enhancements regarding icing, turbulence, convection, ceiling and visibility are now integrated into NOAA's Advanced Weather Information Processing System (AWIPS). For the first time, the NOAA's Center Weather Service Units can use the AWIPS Remote Display (ARD) to view aviation weather products and map backgrounds for use in their aviation forecasting and briefings to the Federal Aviation Administration's (FAA) Traffic Management Units (TMU). These products give visual references to affected airspace. The sophisticated technology allows air traffic controllers and managers and aviation dispatchers to make informed decisions about how to route planes from the path of severe weather events and volcanic ash plumes. The focus of this technology is to increase flight efficiency and safety and minimize delays. These tools are now being demonstrated in Alaska, Texas and Northern Virginia.

New NOAA Tools Allowed Improved Monitoring and Predictions of the 2007 U.S. Drought

NOAA researchers at the Earth System Research Laboratory (ESRL) tested the newly developed Drought Monitoring and Prediction System (DMAPS) on the early 2007 drought in the Western and Southern region of the U.S. This system provides near real-time monitoring and prediction of drought which is an invaluable tool for drought preparation and impact assessment at national to regional scales. The DMAPS uses the North America Land Data Assimilation System, the Variable Infiltration Capacity model, and seasonal climate forecasts for providing quantitative assessments of drought.

Hawaii Sea Grant Beach Restoration Project Wins National Award

The American Shore and Beach Preservation Association awarded Kuhio Beach in Waikiki with a 2008 Best Restored Beaches Award. The project, spearheaded by Hawaii Sea Grant was a pilot project which restored the beach by dredging sand which had eroded offshore instead of the old method of trucking sand in from elsewhere. The $475,000 pilot project dredged 10,000 cubic yards of sand from 2,000 feet offshore to three sites on Kuhio Beach. The sand enlarged the beach by as much as 40 feet and inflated it up to four feet vertically, keeping the beach dry in areas previously inundated with water. In addition, the project cut in half the cost of the old method. In the long-run, it is hoped that the project will facilitate coral reef ecosystem restoration in nearshore areas previously smothered by eroded sand. Restoring Kuhio Beach in Waikiki, which is world-renowned for its expanse of white sand and turquoise water, served as a unique opportunity to demonstrate the value and effectiveness of "recycling" eroded sand as well as restoring a high-value recreational beach for both local residents and tourists alike. The Kuhio Beach restoration project continues to serve as a successful demonstration of the local technical capability, cost effectiveness and environmental soundness of using offshore sediment for local beach restoration.

NOAA Sponsors UAS Flights over Greenland

NOAA's Earth System Research Laboratory and the Cooperative Institute for Research in Environmental Sciences sponsored a three-week Unmanned Aircraft Systems (UAS) mission over Greenland titled Arctic MUSCOX. The "Manta" unmanned aircraft flew a series of flights to observe glacier ice melt, a key but poorly understood parameter that could contribute to a collapse of the Greenland ice sheet, and hence large sea level rise. Using the "Manta", scientists increased the area and frequency of observation and collected data from remote areas difficult to monitor. The "Manta" whose gross maximum weight is 60 pounds can carry a 15-pound payload and fly up to 16,000 feet in altitude for as long as six hours. For this particular mission, the aircraft flew as low as 500 feet over unfamiliar terrain to monitor the melt off. This mission helped develop a new methodology for frequently monitoring a broader area of melt ponds than is feasible with manned aircraft in an inherently dangerous area.

New NOAA Ship Will Change How We Explore the Ocean

NOAA ship *Okeanos Explorer*, "America's Ship for Ocean Exploration," was commissioned on August 13, 2008, setting it on a course to be the only U.S. ship assigned to systematically explore our largely unknown ocean for the purpose of discovery and the advancement of knowledge. Unlike many other ocean expeditions supported by NOAA, missions on this ship will have most of the scientists remaining ashore. Via telepresence, live images from the seafloor and other science data will flow over satellite and high-speed Internet pathways to scientists standing watches in any of five Exploration Command Centers ashore. Those scientists, and others on call if a discovery is made at sea, will add their expertise to missions no matter where in the world the ship is located. The ship will also stream seafloor images and interviews from sea over standard Internet connections to bring the excitement of ocean exploration and discoveries live into classrooms, newsrooms, and living rooms, helping to raise ocean literacy among stakeholders, increasing their ability to make informed decisions about important ocean issues.

NOAA Completes Climate Reference Network in Continental United States

Researchers at NOAA's Air Resources Laboratory (ARL) finished installing the114 stations comprising the U.S. Climate Reference Network (CRN) intended to track national average changes in temperature and precipitation trends with exceptional precision and accuracy. The CRN is helping to pinpoint the shifts in America's changing, often unpredictable, climate. The placement of each CRN station is crucial to obtaining accurate information on current and likely future climatic conditions. All stations are constructed in rural environments, away from urban areas that could confound the interpretation of any precipitation and/or temperature trends observed. Each CRN station logs real-time measurements of surface temperature, precipitation, wind speed and solar radiation. NOAA's geostationary satellites relay the data from these ground-based stations to the National Climatic Data Center, which posts the observations online. As a result of installing the additional stations, NOAA exceeded its goal of improving the percentage of explained variance for temperature and precipitation.

NOAA Climate Modeling Enhanced by Agreement with Department of Energy

As part of a memorandum of understanding between NOAA and the U.S. Department of Energy's (DOE) Office of Science, DOE is making available more than 10 million hours of computing time for NOAA to explore advanced climate change models at three of DOE's national laboratories. Prototypes of advanced, high-resolution climate models from NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) on DOE super computers to study decadal variability and predictability of the climate system; understand the impact of climate change on tropical cyclone activity by integrating our tropical cyclone research into NOAA's global climate modeling efforts; and reduce uncertainty in climate predictions and offer unprecedented regional fidelity beyond today's highly parameterized climate simulations by explicitly resolving deep convective clouds, tropical cyclones, and extreme weather events. In addition, collaboration between DOE specialists and GFDL scientists provided NOAA with valuable information on how we should proceed in visualization of these high-resolution datasets.

NOAA NSSL mobile dual-polarized Doppler radar captures Ike

The first dual-polarized Doppler radar data of a landfalling hurricane eyewall was collected as Hurricane Ike came ashore in Texas in September 2008. The data was collected by a new mobile dual-polarized X-band radar (called NO-XP) built and operated by NOAA NSSL and the University of Oklahoma. Radars with dual-polarization capabilities — radio waves that are sent out both horizontally and vertically — can more accurately determine precipitation types and amounts. NO-XP was on the edge of the western portion of the eyewall, and the maximum wind gust at their location was 85 MPH. The NO-XP is a new mobile radar built to study precipitation processes as well as severe weather and became operational in April 2008. Research data provided by the NO-XP will help improve the quality and accuracy of forecasts and warnings of hazardous weather.

NOAA's Pacific Marine Environmental Laboratory Director Awarded Prestigious Service to America Medal

On September 16, Dr. Eddie Bernard, Director of the Pacific Marine Environmental Laboratory in Seattle, WA, became the first NOAA scientist to be awarded a Service to America Medal at an award ceremony in Washington, D.C. Dr. Bernard received the Homeland Security Medal for creating a tsunami detection system that has dramatically increased warning times and decreased the risk of a catastrophic loss of life. For the millions of Americans who live, work, and tour our treasured coastlines (approximately 53 percent of the U.S. population), his efforts have made their lives and communities safer from tsunami hazards.

Service to America Medals have been presented annually since 2002 by the nonprofit, nonpartisan Partnership for Public Service, to celebrate excellence in our federal civil service. More than 3,000 public servants have been nominated for the award since its inception. Dr. Bernard and Dr. Alexander E. "Sandy" MacDonald, Deputy Assistant Administrator of Oceanic and Atmospheric Research, were both finalists in this year's competition. NOAA's only other previous finalist was former National Hurricane Center Director Max Mayfield.

For more information on the award, please visit:
http://servicetoamericamedals.org/SAM/recipients/profiles/hsm08_bernard.shtml

National Museum of Natural History Ocean Hall
A national exhibition on the global ocean for the National Mall came to fruition in 2008 through a partnership between NOAA and the Smithsonian Institution. Through a five-year effort, the Ocean Hall was designed, developed and fabricated. It is the largest exhibition ever built for the world's most visited natural history museum. Ocean science, technologies and NOAA data were incorporated throughout seven galleries with the goal to promote lifelong ocean education through balanced, engaging and updateable ways. The Ocean Hall also informs, educates and inspires positive actions across a wide variety of ocean issues including climate change and sustainable management of fisheries resources. The Ocean Hall is a cornerstone of the Smithsonian's Ocean Initiative designed to increase public awareness of the ocean's importance to all life.

## 2.0 Strategic and Business Results

### 2.1 NOAA Research Helps to Achieve Strategic Goals

Selected Research accomplishments that demonstrate NOAA Research's ability to help achieve NOAA Strategic Goals, across all goals:

- Climate Goal – Climate Research and Modeling (CL-CRM)
  An external review in FY08 enabled CRM to align its priorities and alternatives with the needs of the external community for operational outlooks and information products. Significant gaps in availability of sustained high-performance computing resources inhibited long integrations with high-resolution models. Uncertainties in FY08 funding were detrimental to progress under UCP: delayed and reduced funding led to reprioritization of activities and reduced air (ARCPAC) and ocean (ICEALOT) field campaigns evaluating aerosols as part of the International Polar Year. Major milestones for FY08 were: IPY field studies in the Arctic region; data analysis from an intensive field campaign in the Gulf of Mexico that used NOAA Ship Ron Brown, 4 aircraft, and several ground stations (to address aerosols' influence on climate, a GPRA measure); large-scale surveys in ocean coastal waters to study the invasion and transport of anthropogenic CO2 and other tracers as part of the North American Carbon Program; and laboratory and theoretical research aimed at quantifying the role of non-CO2 greenhouse gases to better quantify radiative forcing.
- Climate Goal – Climate Research and Modeling – Modeling Predictions Projections (CL-CRM-MPP)
  Major activities include: finalizing and documenting new version of 50km atmospheric model suitable for global studies of hurricane frequency/climate warming connections; reporting on high resolution regional downscaling of Atlantic hurricane activity under global warming; augmenting GFDL contributions to the IPCC model database; performing 1000year model perturbation experiments for assessment of climate sensitivity to uncertainties in terrestrial CO2 dynamics; continuing ESM initialization runs; continuing development of stratospheric resolving AGCM with interactive ozone capability and development and testing of new AM3 Atmospheric model with online aerosols; and development of a new coupled ocean-ice-atmosphere model with a high resolution ocean for decadal predictability studies. At shorter time scales, plans are to: begin CFS

Reanalysis and Reforecast Project; improve GODAS; implement North American Regional Reanalysis in NCEP Central Operations; convert CPC products to GIS format; implement improved web version of Climate Diagnostics Bulletin; release experimental version of the North American Week-2 Precipitation Outlook; complete prototype hourly high resolution global precipitation analyses; and continue development of CTB.

- Climate Goal – Climate Research and Modeling – Analysis and Attribution (CL-CRM-CAA)
  Activities include development of a multi-model approach toward the attribution of U.S. climate variations and change; continuation of Intense Attribution Period and cross-NOAA team to improve attribution capabilities; and initiation of an historical reanalysis of the atmosphere for the 20th century. CRM continues to work on CCSP Synthesis and Assessment products, support the implementation of NIDIS, and transform research findings into experimental climate decision support products to address climate services gaps by RISAs and other boundary organizations working with users.
- Climate Goal – Climate Service Development (CL-CSD)
  NIDIS
  - Began procurement of soil moisture sensors for CRN deployment.
  - Implement experimental version of the USDP
  - Continue the implementation of NIDIS and Coping with Drought including improving partnerships and strategies

  TRACS
  - Continue managing transition grant projects
  - Launch 2-3 new NIDIS related contract projects

  RCC
  - Implement electronic upgrade to ingest system for COOP
  - Conduct site surveys for HCN-M
- Climate Goal – Climate Observation and Monitoring – Observation (CL-COM-OBS)
  - *Atmosphere*: USCRN: 114 commissioned-100%; Begin site surveys, selection, deploy in Alaska; Partnered with USDA and Permafrost Obs Network, collocate sensors. USHCN-M: Site surveys/selections; Begin modernizing SW climate region; Implement web-based metadata documentation/access capability; Complete review AK & HI HCN sites, add to USHCN list. GCOS: Install CRN at Tiksi, Russia; Participate in international activities-GCOS Reference Upper Air Network (GRUAN). U.S. Baseline Surface Radiation Network (US BSRN): Sustain SURFRAD & NOAA STAR and U.S. GEWEX stations (22); Insufficient O&M $-put some in hibernation.
  - *Oceans*: GOOS-continue build out to 100%; Sustaining % a challenge. Tropical Atmospheric Ocean Array (TAO): No funds to begin refresh; Delay transition Res to Ops.
  - *Arctic*: Overall completion held to 11%. Joint US/Russian-Monitor physical/biological system Bering Strait, Chukchi Sea, and Pacific Region of Arctic; Examine state of sea ice; Conduct census of marine life north of Alaska & Chukotka; Build physical/biological data base to detect marine ecosystem response; Mooring recovery and deployment in the Bering Strait; US, Russia, and S. Korea scientists take physical/biological samples across Chukchi Shelf and sea ice region; Traverse Nome to Vladivostok, deploy 6 Argo floats, western Bering Sea.
  - *Forcings*: Sustain existing capability as described in FY07.
- Climate Goal – Climate Observation and Monitoring – Data Management and Info (CL-COM-DMI)
  Contribute to National Climate Services draft plan/strategy led by NOAA. SDS: With NASA & OSTP complete CDR/CIR planning for FY09 funding start. Work with USGEO to develop SOA policy guidance for all agencies. Award grants and contracts; Begin developing CDRs that lead to CIRs; Collaborate with NASA & academic community, long-term partnerships. Prepare monthly "State of Climate Report" press releases and Annual Assessment Report. Develop/deliver CCSP 3.3 and Unified Synthesis Product (SAP) for 21 CCSP Reports. Develop NOAA "what to archive" process/approval policy. Satellites IV&V: With NESDIS STAR develop satellite/*in-situ* reference obs inter-comparison capability. CDMP: Continue rescue-migrate data. NEXRAD: Develop other next generation interactive viewer/data exporter & visualization browse/display tools & prototype system for dual polarized radar. Service Oriented Architecture (SOA): Improve capability to meet

customer demands for data product & info interoperability, linking data sources, analysis, & services into comprehensive processing/delivery capability, i.e., Blended SST and Integrated Surface Data (ISD). CLASS: Transition select components to operational status; CLASS Operations & Planning Board (COPB) established to manage operational components (Directors NCDC, NGDC, NODC).

## 2.2 Business Results

### 2.2.1 Program Management and Controls

At the NOAA level, the NOAA's Program Planning and Integration (PPI) and Programming, Analysis and Evaluation (PA&E) offices provide management oversight from Planning to Programming to Budgeting to Execution (PPBES) using the PPBES process. At the Line Office level, the Climate Program Office provides management oversight for the Climate Goal Programs.

### 2.2.2 Monitoring Cost, Schedule and Performance

Program funding increases to meet planned Program Initiatives are requested through the NOAA PPBES process. Each PPBES Program capability in the Program Operating Plans (POPs) provides cost, schedule, and performance information.

Quarterly, Quad Charts are prepared for the NOAA Budget Office to track Cost, Schedule, and Performance, and update the NOAA CFO and PA&E on Risks and Issues and mitigation strategies.

Below is a sample from the Observations and Analysis POP submitted in May 2008.

**Cost:** **POP Current Program Resources**

| | FY08 | FY09 | FY10 | FY11 | FY12 | FY13 | FY14 | FY15 | TC |
|---|---|---|---|---|---|---|---|---|---|
| CL-COM-DMI Data Management And Information | | | | | | | Attached Documents [0] | | |
| | $0 | $0 | $56,117 | $69,037 | $77,557 | $77,557 | $81,557 | $81,557 | - |
| FTE | 202 | 209 | 211 | 212 | 213 | 214 | 215 | 216 | |
| NOAA Corps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Contractor | 195 | 202 | 216 | 217 | 218 | 220 | 221 | 222 | |
| Associate | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Competitive Research Program | $0 | $0 | $19,847 | $32,767 | $41,287 | $41,287 | $45,287 | $45,287 | - |
| Space Environment Center (C) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| National Climatic Data Center | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Integrated Environmental Applications & Information Center | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Archive, Access & Assessment | $0 | $0 | $16,537 | $16,537 | $16,537 | $16,537 | $16,537 | $16,537 | - |
| GOES Data Archive Project | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Climate Database Modernization - KY | $0 | $0 | $1,361 | $1,361 | $1,361 | $1,361 | $1,361 | $1,361 | - |
| Climate Database Modernization - MD | $0 | $0 | $993 | $993 | $993 | $993 | $993 | $993 | - |
| Quality Assurance/Quality Control - NC | $0 | $0 | $275 | $275 | $275 | $275 | $275 | $275 | - |
| Climate Database Modernization WV | $0 | $0 | $1,434 | $1,434 | $1,434 | $1,434 | $1,434 | $1,434 | - |
| International Pacific Research Center (U of H) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Environmental Data Systems Modernization | $0 | $0 | $9,194 | $9,194 | $9,194 | $9,194 | $9,194 | $9,194 | - |
| Climate Sensors (IOOS) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Climate Satellite Sensor (OOMPS Limb NPP) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Comprehensive Large Array Data Stewardship Sys (CLASS) | $0 | $0 | $6,476 | $6,476 | $6,476 | $6,476 | $6,476 | $6,476 | - |
| CL-COM-OBS Observations | | | | | | | Attached Documents [0] | | |
| | $0 | $0 | $94,400 | $95,600 | $103,300 | $100,800 | $100,800 | $100,800 | - |
| FTE | 203.5 | 233.5 | 246.5 | 246.5 | 245.5 | 245.5 | 245.5 | 245.5 | |
| NOAA Corps | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 3.5 | |
| Contractor | 243.5 | 254.5 | 303.5 | 304.5 | 305.5 | 305.5 | 305.5 | 305.5 | |
| Associate | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Laboratories & Cooperative Institutes | $0 | $0 | $19,874 | $19,874 | $19,874 | $19,874 | $19,874 | $19,874 | - |
| Univ of AL Huntsville Climate Research | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Competitive Research Program | $0 | $0 | $62,099 | $61,299 | $63,399 | $60,899 | $60,899 | $60,899 | - |
| Climate Data & Information | $0 | $0 | $6,237 | $6,237 | $6,237 | $6,237 | $6,237 | $6,237 | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Local Warnings and Forecasts Base | $0 | $0 | $3,824 | $3,824 | $3,824 | $3,824 | $3,824 | $3,824 | - |
| TAO and PIRATA Arrays | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Sustain Cooperative Observer Network | $0 | $0 | $1,871 | $3,871 | $3,871 | $3,871 | $3,871 | $3,871 | - |
| Climate Sensors (IOOS) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Cooperative Observer Network Modernization | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | - |
| Cooperative Observer Network Modernization (C ) | $0 | $0 | $495 | $495 | $6,095 | $6,095 | $6,095 | $6,095 | - |
| **Current Program Total** | **$0** | **$0** | **$150,517** | **$164,637** | **$180,857** | **$178,357** | **$182,357** | **$182,357** | **-** |
| **FTE Total** | **405.5** | **442.5** | **457.5** | **458.5** | **458.5** | **459.5** | **460.5** | **461.5** | |
| **NOAA Corps Total** | **8.5** | **8.5** | **8.5** | **8.5** | **8.5** | **8.5** | **8.5** | **3.5** | |
| **Contractor Total** | **438.5** | **456.5** | **519.5** | **521.5** | **523.5** | **525.5** | **526.5** | **527.5** | |
| **Associate Total** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | |

**Current Program Outputs**

| | FY08 | FY09 | FY10 | FY11 | FY12 | FY13 | FY14 | FY15 | |
|---|---|---|---|---|---|---|---|---|---|
| CL-COM-DMI Data Management And Information | | | | | | | | | Attached Documents [0] |
| Competitive Research Program | | | | | | | | | |
| C2D2: Research Climate Data Sets Transitioned to Operations/Transferred to ARC (Cum Total #) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| C2D2: Climate Data Sets Upgraded/Updated within ARC (Cum Total #) | 18 | 27 | 35 | 43 | 50 | 57 | 64 | 71 | |
| C2D2: Climate Extreme Indices providing Socio-economic Impact Info (Cum Total #) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| C2D2: Paleoclimate Reconstructions (Cum Total #) | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | |
| Space Environment Center (C) | | | | | | | | | |
| National Climatic Data Center | | | | | | | | | |
| SDS: Accepted CDRs undergoing testing and validation (Cum Total #) | 2 | 4 | 8 | 11 | 14 | 17 | 20 | 20 | |
| Integrated Environmental Applications & Information Center | | | | | | | | | |
| Archive, Access & Assessment | | | | | | | | | |
| State of the Climate Report - ECVs Assessed/Reported (Cum Total #) | 20 | 22 | 25 | 28 | 30 | 34 | 38 | 42 | |
| NOAA Obs Systems under near real time QC/QA Network Performance Monitoring (Cum Total #) | 6 | 7 | 7 | 8 | 8 | 9 | 10 | 11 | |
| Safe Storage (Pri & Security Copy) NARA Standards - NCDC only (Cum Total Vol in PBs) | 2.7 | 3.1 | 3.6 | 5 | 8.5 | 15 | 24.3 | 34.3 | |
| GOES Data Archive Project | | | | | | | | | |
| Climate Database Modernization - KY | | | | | | | | | |
| Climate Database Modernization - MD | | | | | | | | | |
| Quality Assurance/Quality Control - NC | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Climate Database Modernization WV | | | | | | | | | |
| CDMP: Pages Digitally Scanned/Imaged (Cum Total # -millions) | 48.3 | 48.4 | 48.6 | 48.7 | 48.9 | 49 | 49.2 | 49.4 | |
| CDMP: Records (data) Manually Keyed and On-Line (Cum Total # -millions) | 60 | 63 | 65 | 68 | 70 | 73 | 75 | 77 | |
| International Pacific Research Center (U of H) | | | | | | | | | |
| Environmental Data Systems Modernization | | | | | | | | | |
| Data/Info Available for On-Line Retieval via WWW (Cum Total Vol in PBs) | 1.8 | 2 | 2.2 | 2.7 | 3.7 | 5.2 | 7.2 | 9.7 | |
| Climate Sensors (IOOS) | | | | | | | | | |
| Climate Satellite Sensor (OOMPS Limb NPP) | | | | | | | | | |
| Comprehensive Large Array Data Stewardship Sys (CLASS) | | | | | | | | | |
| CL-COM-OBS Observations | | | | | | | | Attached Documents [0] | |
| Laboratories & Cooperative Institutes | | | | | | | | | |
| SEBN Reference Stations operational-28 (Cum Total #) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Univ of AL Huntsville Climate Research | | | | | | | | | |
| Competitive Research Program | | | | | | | | | |
| Arctic Ocean System Completed/Sustained (Cum Total %) | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | |
| GOOS: Tide Gauges Installed/Maintained - 170@100% (Cum Total #) | 101 | 101 | 113 | 123 | 133 | 145 | 158 | 158 | |
| GOOS: Tropical Buoys Deployed and Sustained - 131@100% (Cum Total #) | 103 | 112 | 112 | 115 | 117 | 118 | 119 | 119 | |
| GOOS: Ocean Reference Stations Operational - 87@100% (Cum Total #) | 47 | 47 | 50 | 51 | 52 | 55 | 58 | 58 | |
| GOOS: SOOP Annual High Resolution Transects - 51/yr (Cum Total #/yr) | 41 | 41 | 43 | 43 | 43 | 45 | 45 | 45 | |
| GOOS: Ocean Carbon Surveys Conducted Annually - 37/yr (Cum Total #/yr) | 22 | 26 | 29 | 31 | 34 | 37 | 37 | 37 | |
| CTOS stations operational - 28 (Cum Total #) | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | |
| NWS Upper Air (RRS) U.S. sites Dual Capable w/Ref Sonde (Cum Total #) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Climate Data & Information | | | | | | | | | |
| USCRN (lower 48-CONUS) sites commissioned-114 (Cum Total #) | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | |
| USCRN in Alaska sites commissioned-29 (Cum Total #) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| GCOS: GSN sites upgraded ~75 (Cum Total #) | 0 | 0 | 4 | 8 | 12 | 16 | 18 | 20 | |
| GCOS: GRUAN sites ~30 upgrade/operational (Cum Total #) | 0 | 0 | 0 | 0 | 2 | 5 | 8 | 11 | |
| Local Warnings and Forecasts Base | | | | | | | | | |
| TAO and PIRATA Arrays | | | | | | | | | |
| TAO Buoys Refreshed (102) (Cum Total #) | 2 | 19 | 36 | 53 | 69 | 85 | 102 | 102 | |
| Sustain Cooperative Observer Network | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Replace F&P (HPD) Paper Tape Recorders with Digital Recorders (Cum Total #) | - | - | - | - | - | - | - | - | |
| | Climate Sensors (IOOS) | | | | | | | | | |
| | Cooperative Observer Network Modernization | | | | | | | | | |
| | Cooperative Observer Network Modernization (C ) | | | | | | | | | |
| | USHCN-M Climate Regions (9) Completed (Cum Total #) | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | |

## 2.3 Reviews

OMB PART Reviews. The Climate Program was reviewed 2/6/2006. Individual component weights/scores: Purpose and Design (20%/80%); Planning (10%/90%); Management (20%/82%); Results (50%/74%) for an Average Score of 78.4%.

The Tsunami program (part of the Weather and Water goal and is captured within this Sceintific Computing Support investment) was review this FY. The results were above expectation – 3 stars (effective). There has been no NOAA program ever reviewed for PART in the past that has gotten that high rating. Details here:
http://www.whitehouse.gov/omb/expectmore/summary/10009082.2008.html

***NOAA/Department of Commerce Review Process.***

Budget Increase Review. NSSL's MPAR BY10 Increase for $1M, where $150K is for IT components. OAR requested through the NOAA Budget Office an increase for the Multi-function Phased Array Radar (MPAR) project to continue research to demonstrate that MPAR technology can cost effectively replace aging operational weather (WSR-88D) and aircraft tracking radars. The NOAA Budget Office reviewed the Two-Page narrative through the PPBES normal chain. The NOAA Office of the CIO (NOAA OCIO) then reviewed the IT portion of the request through a desktop-exercise executed by NOAA OCIO staff. Other NOAA Research budget increases include High-Performance Computing and Communications Decadal Predictions and Abrupt Change and the Climate Model Data Research - National Climate Model Portal; both of which are submitted and handled through other investments outside of the Scientific Computing Support area.

***NOAA Research Review Process.***

NOAA CIO Review Process. Each lab is represented by a Senior IT Manager. The Senior IT Managers meet annually face-to-face and weekly via teleconference with the NOAA Research CIO and staff to discuss the management and technical issues and challenges associated with DOC and NOAA policy as it impacts NOAA Research enterprise IT planning, IT security/information assurance, acquisition strategies, and web presence.

Laboratory Review Process. IT investments are reviewed by lab project managers to determine if Program benefits have been realized in areas such as lowered cost, reduced cycle time, increased quality, additional quantity of services, and increased speed of service delivery. Technology maintenance and refreshment is applied, if indicated in post implementation reviews, based on the following indicators, for COTS software, scientific desktop systems, applications, and server/networking equipment and services:

- upgrades - dependencies are vendor announcements of new technology and industry trends (e.g., Linux verses proprietary operating systems);
- refreshers - includes reaching a predefined age, component failure, repeated maintenance calls on the component failure to meet the system requirement, mission failure, planned

obsolescence of the component resulting in the vendor's inability to maintain the component, vendor has gone of business or been acquired;
- insertion - dependencies are vendor or developer announcements of a product line that meets or increases component capability, vendor or developer announcements of a product line that decreases cost industry trends (e.g. Linux vs. proprietary operating systems), announcements of a milestone of research and development effort resulting in a new capability that can be applied to the laboratory or Program Office.

IT investments are refreshed with the periodic replacement of COTS components; e.g., processors, displays, computer operating systems, commercially available software (CAS), and communications capabilities within larger systems to assure continued supportability of that system through an indefinite service life under the following criteria:

- existing system component has malfunctioned and either cannot be repaired, or the repair costs exceed the replacement costs,
- existing system component has reached its life expectancy
- surrounding technical infrastructure has evolved and is incompatible with the existing component under consideration,
- newer technology has come to market that provides more capability for the same or lower Total Cost of Ownership, and
- requirements of the system have evolved to the extent that the system cannot meet the requirements with the existing technology

### 2.4 Security

The NOAA Research Scientific Computing Support systems are accredited under requirements spelled out by FISMA and the NOAA Security Memo NOA 212-13 that is based on OMB and NIST guidance. System Security Plans, Risk Assessments, and Contingency Plans are certified and accredited and are all current for all systems which are components of the NOAA Research Scientific Computing Support system. Management, operational, and technical security controls are adequate to ensure the confidentiality, integrity and availability of information.

All OAR systems contributing to the NOAA Research Scientific Computing Support system were scheduled to be re-certified and re-accredited by the end FY08 (with half being completed in FY07). This was a significant effort within the IT community in the OAR Line Office. Due to the dilligence and hard work of the community, all systems were succesffully C&A'ed using the latest SP800-53 controls set forth by OMB. In addition, all systems are continuously monitored for security incidents by the NOAA Computer Incident Response Team (N-CIRT) and undergo quarterly vulnerability assessments. There is an annual continuous monitoring self-assessments of all security controls.

### 2.5 Performance Measures

Performance management at the NOAA corporate level consists of a suite of performance measures called Corporate Performance Measures (CPMs). These performance measures help the NOAA Administrator and senior management ensure the organization is moving towards strategic planning goals and outcomes, and organizational priorities. CPMs focus on high-level Program and Goal outcomes and the performance objectives that lead to these outcomes. They should serve to communicate NOAA's corporate performance to external audiences and provide a basis for the internal evaluation of NOAA's progress to plan.
The performance measures in Table 2 show the Scientific Computing Support's performance with respect to Strategic and Business Results. Strategic and Business Results performance measures introduced in [reporting year] include "[example measure]" and "[example measure]." These measures align with the "Mission and Business Results Measurement Area," "Processes and Activities Measurement Area" and the "Technology Measurement Area" of the Performance Reference Model developed by the FEA-PMO.

**Table 2: Business Results Performance Measures**

| Measurement Area | Indicator | [reporting year – 1] Baseline | [reporting year] Actual Result | Comments |
|---|---|---|---|---|
| Strategic and Business Results | Climate Observation and Analysis; CDRs undergoing operational testing and validation. (Cumulative Total #) | 2 | 3 | |
| | Reduce the uncertainty in the magnitude of the North American carbon uptake | +/- 0.4 gtC | +/- 0.4 gtC | |
| | Reduce the error in global measurement of sea surface temperature | .5C | .5C | |
| | U.S. temperature forecasts (cumulative skill score ove the regions where predictions are made) | 19 | 25.6 | |
| | Number of regionally focused climate impacts and adaptation studies communicated to decision makers | 35 | 37 | |
| | Improved estimates of the magnitude, associated error, and sources of variability on atmospheric forcing agents | 56% | 56% | |
| | Determine the National explained variance (%) for temperature and precipitation for the contiguous United States using USCRN stations | temp (97.7%); precip (93.8%) | temp (98.3%); precip (95.1%) | |
| | Reduce uncertainty in model simulations of the influence of aerosols on climate | 12% | 12% | |

## 3.0 Financial Performance

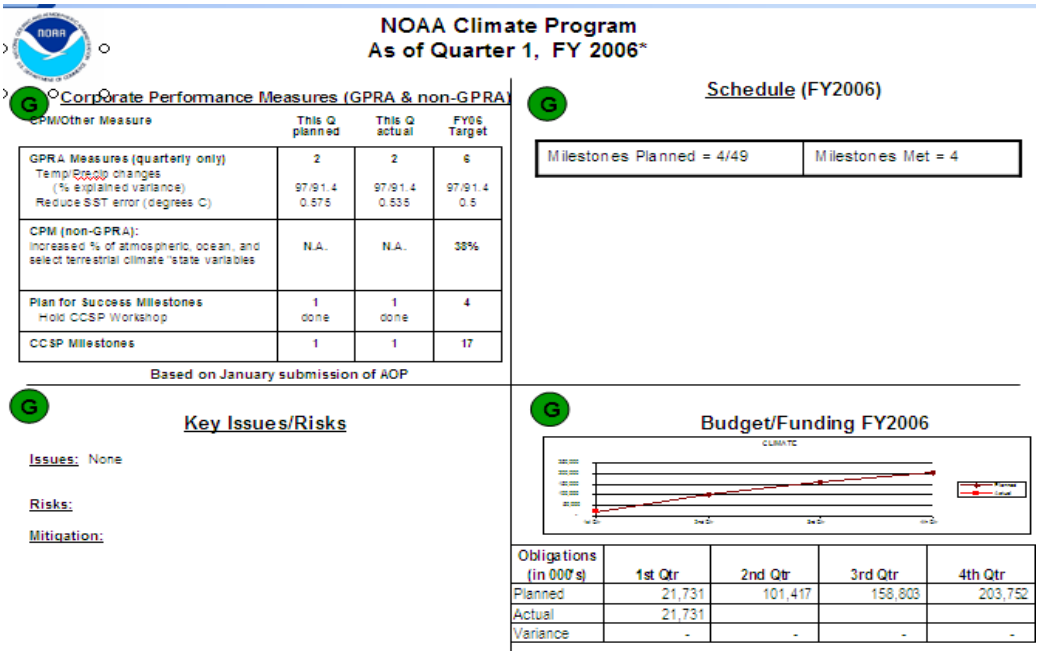
### 3.1 Current Performance vs. Baseline

The Department of Commerce's Financial Management System is used by OAR to track all financial obligations and commitments. The Budget Execution office with OAR ensures baseline and current spending are appropriated accordingly.

### 3.2 Performance Measures

Via the PPBES Quad Chart reporting, program performance measures are mapped to project milestone activities, planned and obligated budget spending, and any risks or issues with associated mitigation strategies. The Scientific Computing Support investment spans over the following NOAA Goals: Climate, Weather and Water, and Ecosystem.

The quad chart below is just a sample but actual charts are available in Appendix D



**NOAA Climate Program**
**As of Quarter 1, FY 2006***

**Corporate Performance Measures (GPRA & non-GPRA)**

| CPM/Other Measure | This Q planned | This Q actual | FY06 Target |
|---|---|---|---|
| GPRA Measures (quarterly only)<br>Temp/Precip changes<br>(% explained variance)<br>Reduce SST error (degrees C) | 2<br><br>97/91.4<br>0.575 | 2<br><br>97/91.4<br>0.535 | 6<br><br>97/91.4<br>0.5 |
| CPM (non-GPRA):<br>Increased % of atmospheric, ocean, and select terrestrial climate "state variables | N.A. | N.A. | 38% |
| Plan for Success Milestones<br>Hold CCSP Workshop | 1<br>done | 1<br>done | 4 |
| CCSP Milestones | 1 | 1 | 17 |

Based on January submission of AOP

**Schedule (FY2006)**

| Milestones Planned = 4/49 | Milestones Met = 4 |
|---|---|

**Key Issues/Risks**

Issues: None

Risks:

Mitigation:

**Budget/Funding FY2006**

| Obligations (in 000's) | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
|---|---|---|---|---|
| Planned | 21,731 | 101,417 | 158,803 | 203,752 |
| Actual | 21,731 | | | |
| Variance | - | - | - | - |

*Sample PPBES Quad Chart – Climate Program*

### 3.3 Cost Benefit Analysis

In 2008, NOAA CIO Office continued the process by which the PPBES Goal Team Leads annually provide planned costs for IT. The responses to the cost matrix are coordinated by the Goal Team Leads (e.g., Climate Program Office) and are intended to be used to assess the impact of alternatives proposed to meet gaps in Program capabilities. IT planning costs are estimated in parallel with the Program Operational Plans (POPS) planning phase of the PPBES process.

Scientific Computing Support IT Investment FY2009 Planning Estimates are included as a table below (using the latest Exhibit 53 from 2008 data).

**Summary of Spending for Project Stages - Cost in thousands**

| | PY 2008 | CY 2009 | BY 2010 | BY + 1 2011 | BY + 2 2012 | BY + 3 2013 | BY + 4 2014 | BY + 5 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Operations & Maintenance | | | | | | | | | $9,861.61 |
| Budgetary Resources | $20,479.57 | $21,610.40 | $22,080.85 | $22,562.37 | $23,055.24 | $23,559.77 | $24,076.24 | $24,604.96 | **$182,029.41** |
| Government FTE Costs: Assumption is made that Govt FTEs are base funded, not funded from reimbursables. | | | | | | | | | |
| Budgetary Resources | $8,417.72 | $8,631.44 | $8,868.26 | $9,111.95 | $9,362.72 | $9,620.78 | $9,886.35 | $10,159.66 | **$74,058.89** |
| Ops & Maint. minus FTES and minus reimbursables | $9,561.77 | $10,407.52 | $10,561.61 | $10,722.26 | $10,879.45 | $11,043.15 | $11,203.32 | $11,369.90 | **$85,748.98** |

**Provide the number of Government Full Time Equivalents (FTE) represented by the Government FTE Costs in the Summary of Spending Table.**

| | PY 2007 | CY 2008 | BY2009 | BY + 1 2010 | BY + 2 2011 | BY + 3 2012 | BY + 4 2013 | BY + 5 2014 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Security | 7.98 | 8.11 | 8.61 | 8.61 | 8.61 | 8.61 | 8.61 | 8.61 | **67.71** |
| IT | 38.66 | 39.73 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | **319.81** |
| Financial Management | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** |
| Program Management | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | **14.40** |
| Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** |
| Number of FTEs | 48.44 | 49.64 | 50.64 | 50.64 | 50.64 | 50.64 | 50.64 | 50.64 | **401.92** |

**Funding Sources - Cost in thousands**

| FS Name: MAX Code | PY - 2007 | CY 2008 | BY 2009 | BY + 1 2010 | BY + 2 2011 | BY + 3 2012 | BY + 4 2013 | BY + 5 2014 | Total |
|---|---|---|---|---|---|---|---|---|---|
| NOAA ORF | $17,980.59 | $18,958.80 | $19,466.78 | $19,995.08 | $20,534.20 | $21,094.57 | $21,666.84 | $22,261.46 | **$161,958.32** |
| NOAA PAC | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | **$0.00** |
| Other Agency Funding/non-NOAA Reimbusables | $2,500.08 | $2,571.45 | $2,650.98 | $2,728.15 | $2,813.07 | $2,895.83 | $2,986.57 | $3,075.40 | **$22,221.53** |
| Total Yearly Budgets | $20,480.67 | $21,530.24 | $22,117.76 | $22,723.23 | $23,347.27 | $23,990.41 | $24,653.41 | $25,336.86 | **$184,179.85** |
| Funding Sources Table in E300 includes $700K DME for OKEANOS | | | | | | | | | |
| ORF and PAC Only | $17,980.59 | $18,958.80 | $19,466.78 | $19,995.08 | $20,534.20 | $21,094.57 | $21,666.84 | $22,261.46 | **$161,958.32** |
| %ORF and PAC | 0.878 | 0.881 | 0.880 | 0.880 | 0.880 | 0.879 | 0.879 | 0.879 | |
| SECURITY | $1,799.76 | $1,862.15 | $1,895.67 | $1,929.80 | $1,964.53 | $1,999.89 | $2,035.89 | $2,072.54 | **$15,560.24** |
| $Security | $1,580.06 | $1,639.75 | $1,668.46 | $1,698.10 | $1,727.83 | $1,758.49 | $1,789.26 | $1,820.97 | **$13,682.93** |
| %Security | 0.088 | 0.086 | 0.086 | 0.085 | 0.084 | 0.083 | 0.083 | 0.082 | |
| HARDWARE | $2,278.17 | $2,419.18 | $2,462.73 | $2,507.05 | $2,552.18 | $2,598.12 | $2,644.89 | $2,692.49 | **$20,154.82** |
| $Hardware | $2,000.08 | $2,130.25 | $2,167.55 | $2,206.06 | $2,244.67 | $2,284.51 | $2,324.48 | $2,365.68 | **$17,723.27** |
| % Hardware | 0.111 | 0.112 | 0.111 | 0.110 | 0.109 | 0.108 | 0.107 | 0.106 | |
| SOFTWARE | $685.34 | $757.68 | $771.31 | $785.20 | $799.33 | $813.72 | $828.37 | $843.28 | **$6,284.23** |
| $Software | $601.68 | $667.18 | $678.87 | $690.93 | $703.02 | $715.50 | $728.02 | $740.92 | **$5,526.11** |
| % Software | 0.033 | 0.035 | 0.035 | 0.035 | 0.034 | 0.034 | 0.034 | 0.033 | |
| SERVICES | 7902.252 | 8124.493 | 8270.734 | 8419.607 | 8571.160 | 8725.441 | 8882.498 | 9042.383 | **$67,938.57** |
| $Services | $6,937.62 | $7,154.15 | $7,279.42 | $7,408.75 | $7,538.44 | $7,672.21 | $7,806.45 | $7,944.81 | **$59,741.86** |
| % Services | 0.386 | 0.377 | 0.374 | 0.371 | 0.367 | 0.364 | 0.360 | 0.357 | |
| OTHER (Facilities) | $553.06 | $563.01 | $573.15 | $583.47 | $593.97 | $604.66 | $615.54 | $626.62 | **$4,713.48** |
| OTHER (Training) | $937.73 | $984.61 | $1,002.33 | $1,020.37 | $1,038.74 | $1,057.44 | $1,076.47 | $1,095.85 | **$8,213.53** |
| OTHER (Telecon) | $542.00 | $951.76 | $968.89 | $986.33 | $1,004.09 | $1,022.16 | $1,040.56 | $1,059.29 | **$7,575.08** |
| OTHER (FTE) | $5,781.26 | $5,947.52 | $6,136.03 | $6,330.54 | $6,531.25 | $6,738.34 | $6,952.02 | $7,172.51 | **$51,589.47** |
| TOTAL | $7,814.05 | $8,446.90 | $8,680.40 | $8,920.71 | $9,168.04 | $9,422.59 | $9,684.60 | $9,954.27 | **$72,091.56** |
| $Other Services | $6,860.19 | $7,438.05 | $7,639.99 | $7,849.69 | $8,063.40 | $8,285.21 | $8,511.38 | $8,746.02 | **$63,393.93** |
| % Other Services | 0.382 | 0.392 | 0.392 | 0.393 | 0.393 | 0.393 | 0.393 | 0.393 | |
| | | | | | | | | | $160,068.10 |

### 3.4 Financial Performance Review

On an annual basis, the Senior IT Managers report to the lab Director to identify technical refresh requirements for software, hardware, and services to meet steady state operations within the laboratory's baseline IT budget. These requirements are prioritized and implemented as budgeted.

## 4.0 Innovation to Meet Future Customer Needs

On-site partnerships provide a unique opportunity for close collaboration, while sharing infrastructure costs, equipment, and personnel to make better use of technology and lower operating costs.

Facilities. The GLERL laboratory is in the process of moving their offices to a new location. A brand new building was recently built to accommodate for the office. GLERL's old office facility is very old and a lot of health issues (such as asbestos, lead, etc) have come to surface in the past decade. The new facility will ensure continuity of operations and maintain its scientific preeminence.

Technology. Within the past three years, NOAA Research Headquarters leadership implemented an OAR-wide Webcast. It aims to provide OAR employees information about NOAA, the organization, and any scientific accomplishments within the Line Office. This year, in FY2008, the Webcast program is in full deployment and is schedule quarterly. All laboratories within the OAR Line Office has the opportunity to get quarterly "live web-based broadcast" updates on anything NOAA and OAR.

Technology. Google Earth / Maps Applications are available for use within NOAA through the enterprise agreement with Google led by the NOAA CIO's office with the help of the GIS committee and representatives from each Line Office. This provided developers and scientist alike a tool to disseminate their data and research information to the public and to collaborative entities. An example of utilizing this technology by the labs within the Scientific Computing Support Investment include the ESRL / GMD Observation Sites map: http://www.esrl.noaa.gov/gmd/dv/site/map1.html,

### 4.1 Number and Types of Users

The fiscal year 2008 enacted budget for OAR totaled $398.1M. The fiscal year 2009 President's budget request for OAR is $382.6M.

OAR has 771 permanent Federal employees, 827 Associates, 439 Contractors and 14 Commissioned Officers.

Within NOAA, cross collaboration is across Line Offices (NWS, NESDIS, NOS, and NMFS) in support of other NOAA Programs such as **NOAA's National Marine Sanctuary Program.**

Partnerships also include other Federal agencies such as National Aeronautics and Space Administration and the U.S. Department of Energy.

Other partnerships include the National Center for Atmospheric Research (NCAR), a National Science Foundation federally funded research and development center.

And university partnerships, such as the Western Water Assessment. (http://wwa.colorado.edu/about/index.html).

The Assessment was created in 1999 and is a joint effort between the Cooperative Institute for Research in Environmental Sciences at the University of Colorado and the National Oceanic and Atmospheric Administration's Climate Diagnostics Center. Both entities are located in Boulder, Colorado. The WWA director and 2 research associates are both housed in ESRL/PSD.

Each laboratory is also co-located, under a DOC/NOAA/OAR Formal Research Partnership, with a Joint and Cooperative Institute.

Over the past thirty two years, the Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), Office of Oceanic and Atmospheric Research (OAR) through its NOAA Research Laboratories has developed research partnerships to form the Joint Institutes. Each of these Joint and Cooperative Institutes are formal, collaborative long-term research partnerships established under a Memorandum of Understanding (MOU)/Agreement (MOA) between NOAA through the Office of the Under Secretary of Oceans and Atmosphere and participating universities and non-profit research institutions with programs dedicated to oceanographic and/or atmospheric research, education and outreach. By design, most of the Institutes are geographically co-located with one or more NOAA facilities to promote scientific interchange and collaboration.

The primary purpose of each Institute is to create a mechanism to bring together the resources of a research-oriented university or institution, OAR and other branches of NOAA in order to develop and maintain a center of excellence in research relevant to understanding the Earth's oceans, the Great Lakes, inland waters, Arctic regions, solar terrestrial environment, inter-mountain west and the atmosphere. These partners provide a pooling of resources for studies to produce the best possible interdisciplinary scientific research and outreach. These exceptionally worthwhile undertakings are substantial, long enduring and represent a synergy that has brought together NOAA, premier academic and oceanographic institutions in a mutually beneficial arrangement to address issues of national and international significance unique to these partnerships.

For detailed information see Appendix B below.

### 4.2 Funding Levels

**Finding efficiencies to do more with the same amount of resources.**

For FY2008, the breakout for the E300 SCS IT costs were: 3.3% for software; 11.1% hardware; 38.6% services; and 38.2% other (facilities and other). Of those costs, 8.8% were for IT Security.

Software Licensing and Maintenance. All of NOAA has benefited from NOAA Research's efforts to work with the NOAA Acquisition Community and COTS software publishers in negotiating enterprise software licensing BPAs and Contracts. These products can be costly since they serve a "niche" market of scientists and researchers.

For example, NOAA holds a contract for Interactive Data Language (IDL) – software for data analysis, visualization, and cross-platform application development. The original 5 year contract for IDL software was awarded in 2000 as site licensing to OAR and NESDIS. The contract was re-negotiated in 2006, and NWS NCEP was added as another "site". The commercial cost of a floating network license is $3,900; a single license is $3,000, and a node locked license $2,400; pricing includes one year of maintenance. Under this contract, the FY2006 annual renewal cost for over a 1000 programmers within these Line Offices was $128,000 (approximately $128 per user). NCEP's 200 users paid $175 for a license and a year of maintenance under the new contract. The cost avoidance for NCEP alone, at single license fees, was 58%. This contract is still in effect in FY2008 and has benefited numerous other programs within NOAA.

Another cost-efficiency for enterprise software licensing is for Linux (the basic workstation entitlement is discounted 40% from list). The existing BPA with Red-Hat expired in FY2008 and it has been re-negotiated and re-awarded for another three years. This contract BPA has benefited NOAA as an enterprise and will continue to do so in the future.

The NOAA CIOs as a team effort, out of their own IT budgets, fund the contract for ISIResearchSoft EndNote, ProCite, and Reference Manager publishing software. Researchers and librarians use EndNote to search online bibliographic databases, organize their references, images and PDFs in any language,

and create bibliographies and figure lists instead of spending hours typing bibliographies, or using index cards to organize their references. EndNote is a valuable all-in-one publishing tool for both Windows and MacIntosh platforms. The site licensing annual renewal, which includes home use, costs $21,600. A single license is priced at $240. The current contract is in its second option year and has continued to provide cost savings for NOAA since it is an enterprise volume license buy.

## Appendix A

**Earth Systems Research Laboratory (ESRL) – http://www.esrl.noaa.gov/**

The Earth System Research Laboratory's mission is to observe and understand the Earth system and to develop products through a commitment to research that will advance the National Oceanic and Atmospheric Administration's (NOAA's) environmental information and services on global-to-local scales. The work at the Earth System Research Laboratory includes:

- understanding the roles of gases and particles that contribute to climate change,
- providing climate information related to water management decisions,
- improving weather prediction,
- understanding the recovery of the stratospheric ozone layer, and
- developing air quality forecast models.

**National Severe Storms Laboratory (NSSL) – http://www.nssl.noaa.gov/**

NSSL studies severe and hazardous weather processes and develops tools to help National Weather Service forecasters, and federal, university and private sector partners use weather information more effectively.

The three research divisions - Forecast, Warning, and Radar - carry out NSSL's core science by blending resources, talent, knowledge and shared goals to:

- Develop enhancements to existing weather radar, and to design and test a new radar system.
- Develop and test tools to improve forecasts and warnings.
- Develop hydrometeorology tools for severe storm monitoring and prediction
- Carry out field research to improve the basic understanding of severe storm processes.

**Pacific Marine Environmental Laboratory (PMEL) – http://www.pmel.noaa.gov/**

PMEL carries out interdisciplinary scientific investigations in oceanography and atmospheric science. Current PMEL programs focus on open ocean observations in support of long-term monitoring and prediction of the ocean environment on time scales from hours to decades. Studies are conducted to improve our understanding of the world's oceans, to define processes driving the global climate system, and to improve environmental forecasting capabilities for public safety, marine commerce, and fisheries.

Ocean Environment Research

- Tsunami (hazard mitigation)
- VENTS (hydrothermal studies)
- FOCI (fisheries oceanography)
- SEBSCC (ecosystem studies)

Ocean Climate Research

- Argo Profiling Floats
- Atmospheric Chemistry
- Carbon Dioxide
- Chlorofluorocarbons
- TAO (buoy array)
- TMAP (equatorial ocean modeling)

**Atlantic Oceanographic and Meteorological Laboratory (AOML) – http://www.aoml.noaa.gov/**

AOML's mission is to conduct basic and applied research in oceanography, tropical meteorology, atmospheric and oceanic chemistry, and acoustics. The research seeks to understand the physical characteristics and processes of the ocean and the atmosphere, both separately and as a coupled system.

The Physical Oceanography Division of AOML carries out interdisciplinary scientific investigations in the field of Ocean and Climate. Specific research goals are: Determine the role of the ocean in long term climate change; Study ocean variability and its influence on short term climate and weather and to provide data analysis and assimilation tools for ocean prediction.

PhOD is a main partner in the development of a sustained Ocean Observing system for Climate to support NOAA mission requirements. As such the overall mission of the Physical Oceanography Division of AOML is to provide quality ocean data and products in a timely and cost-effective manner to satisfy NOAA nowcast, forecast, detection, attribution and research mission requirements.

The Hurricane Research Division (HRD) is a part of the Atlantic Oceanographic and Meteorological Laboratory (AOML). We are engaged in advancing the basic physical understanding and improving the forecasts of hurricanes and tropical meteorological systems. A key aspect of HRD's activity is its annual field program of flights aboard NOAA's research aircraft (two WP-3D turboprops and a Gulfstream IV-SP jet) flown by NOAA's Aircraft Operations Center.

The Ocean Chemistry Division (OCD) is one of the four scientific research divisions within the Atlantic Oceanographic and Meteorological Laboratory (AOML). The diverse Ocean Chemistry Division scientific staff is comprised not only of chemical oceanographers and atmospheric chemists but also biological oceanographers and geologists. OCD typically employs multi-disciplinary approaches to solve scientific research questions central to National Oceanic and Atmospheric Administration (NOAA) mission requirements. The division's work includes projects that are important both in enhancing our basic understanding of the coupled atmospheric/ocean system but also in assessing the current and future effects of human activities on the coastal and oceanic environments. Detailed information about specific research projects can be found within the major research areas section of this site.

**Great Lakes Environmental Laboratory (GLERL) – http://www.glerl.noaa.gov/**

GLERL was formed in 1974 to provide a focus for NOAA's environmental and ecosystem research in the Great Lakes. GLERL conucts high-quality research and provides scientific leadership to understand, observe, assess, and predict the status and changes of Great Lakes and coastal marine ecosystems to educate and advise stakeholders of optimal management strategies.

Presently GLERL's research resides under NOAA's Ecosystem Goal Team specifically in the Ecosystem Research Program. During its history, GLERL has made many important scientific contributions to the understanding and management of the Great Lakes and other coastal ecosystems. GLERL scientists thus play a critical role in academic, state, federal, and international partnerships, and GLERL research provides information and services to support decisions that affect the environment, recreation, public health and safety, and the economy of the Great Lakes and coastal marine environments. GLERL's main science issue areas are Physical Environment , Water Quantity, Water Quality, Human Health, Fish Recruitment and Productivity, and Invasive Species

**Air Resources Laboratory (ARL) – http://www.arl.noaa.gov/**

The Air Resources Laboratory (ARL) studies processes and develops models that relate to air quality and climate, concentrating on technology development and transfer relating to the transport, dispersion, transformation and removal of trace gases and aerosols (the exchange between the atmosphere and the surface), and the role of natural variability. The time frame of interest ranges from minutes to that of the global climate.

ARL research is aligned with the four thematic areas of NOAA Research; **weather and air quality**, **coastal and ocean resources**, **climate**, and **technology development and transfer**, with emphases on homeland security, coastal ecosystems, and arid-zone environments. The specific goal of ARL research is to improve and eventually to institutionalize prediction of air quality, atmospheric deposition, and related variables. ARL operates with research divisions in Idaho Falls, Idaho; Research Triangle Park, North Carolina; Las Vegas, Nevada; Oak Ridge, Tennessee; and Silver Spring, Maryland. On October 1, 2005, the Surface Radiation Research Branch in Boulder, Colorado, formerly a division of the Air Resources Laboratory, was merged into the Earth System Research Laboratory (ESRL).

**Geophysical Fluid Dynamics Laboratory – http://www.gfdl.noaa.gov/**

The goal of this research is to expand the scientific understanding of the physical processes that govern the behavior of the atmosphere and the oceans as complex fluid systems. These systems can then be modeled mathematically and their phenomenology can be studied by computer simulation methods. GFDL research concerns the predictability of weather on large and small scales; the structure, variability, predictability, stability and sensitivity of global and regional climate; the structure, variability and dynamics of the ocean over its many space and time scales; the interaction of the atmosphere and oceans, and how the atmosphere and oceans influence and are influenced by various trace constituents; the Earth's atmospheric general circulation within the context of the family of planetary atmospheric circulations.

The scientific work of the Laboratory encompasses a variety of disciplines including meteorology, oceanography, hydrology, classical physics, fluid dynamics, chemistry, applied mathematics, and numerical analysis. Research is also facilitated by the Atmospheric and Oceanic Sciences Program (AOSP), which is a collaborative program at GFDL with Princeton University. Under this program, regular Princeton faculty, research scientists, and graduate students participate in theoretical studies, both analytical and numerical, and in observational experiments in the laboratory and in the field. The program is supported in part by NOAA funds. AOSP scientists may also be involved in GFDL research through institutional or international agreements.

## Appendix B

### Number and Types of Users – University Partnerships

The Joint Research Institutes bring together the resources of a research-oriented university or institution, OAR and other branches of NOAA in order to develop and maintain a center of excellence in research relevant to understanding the Earth's oceans, the Great Lakes, inland waters, Arctic regions, solar terrestrial environment, intermountain west and the atmosphere.

Cooperative Institute for Arctic Research (CIFAR)
Fairbanks, AK--
CIFAR is designed to serve as a focal point for interactions between NOAA and the Arctic research community through the University of Alaska for research activities related to NOAA's tasks and responsibilities in the Arctic. CIFAR conducts research on a wide variety of issues critical to the Arctic, including fisheries oceanography, hydrographic studies and sea ice dynamics, atmospheric research, climate dynamics and variability, tsunami research and prediction, and environmental assessment and monitoring. CIFAR works closely with researchers from the eight countries of the Arctic Council on climate impact assessments, and is planning joint oceanographic cruises with Russia.

Cooperative Institute for Atmospheric Sciences and Terrestrial Applications (CIASTA)
Las Vegas/Reno, NV--
CIASTA is a cooperative institute among NOAA and the University and Community College System of Nevada (UCCSN). CIASTA is administered by the Desert Research Institute on behalf of the UCCSN. CIASTA brings a formalized focus to a number of research projects and programs encompassing weather research, climate, air quality and terrestrial ecosystems studies related to global change and hydrology and water supply in the arid regions typical of the intermountain West. CIASTA supports university researchers, postdocs and students.

Cooperative Institute for Climate Applications and Research (CICAR)
Palisades, NY--
CICAR is a cooperative institute between NOAA and Columbia University, New York. CICAR research themes include the modeling, understanding, prediction and assessment of climate variability and change; development, collection, analysis and archiving of instrumental and paleoclimate data; and development of the application of climate variability and change prediction and assessment to provide information for decision makers and assess risk to water resources, agriculture, health, and policy. CICAR brings together scientists from NOAA Laboratories, in particular the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, and scientist of the Earth Institute at Columbia University, in particular the Lamont Doherty Earth Observatory.

Cooperative Institute for Climate and Ocean Research (CICOR)
Woods Hole, MA--
CICOR is a cooperative institute between NOAA and the Woods Hole Oceanographic Institution. The research activities of CICOR will be organized around three themes: the coastal ocean and near-shore processes, the ocean's participation in climate and climate variability, and marine ecosystem processes analysis. These theme areas, each of which has significant implications for human society, are interrelated, and scientific progress will require collaborations by scientists within and between disciplines. In each case, progress will depend on a combination of fundamental process studies, the development and deployment of technological systems for sustained observation, and the development of predictive models that are based on an understanding of the underlying processes and that assimilate information from observational systems.
Cooperative Institute for Climate Science (CICS)
Princeton, NJ--
CICS is built upon the strengths of Princeton University in biogeochemistry, physical oceanography, paleoclimate, hydrology, ecosystem ecology, climate change mitigation technology, economics and policy; and those of GFDL in modeling the atmosphere, oceans, weather and climate. CICS is an outgrowth of a highly successful forty-year collaboration between Princeton University's Atmospheric and

Oceanic Sciences (AOS) Program and GFDL that contributed to the development of oceanic and atmospheric models, performed research on climate and biogeochemical cycling and educated several generations of postdoctoral researchers and graduate students. The establishment of CICS enhances and extends this long-term partnership by incorporating Princeton University faculty affiliated with the interdisciplinary Princeton Environmental Institute (PEI), thereby augmenting its expertise in the sciences, engineering and policy and facilitating new research collaborations.

Cooperative Institute for Limnology and Ecosystems Research (CILER)
Ann Arbor, MI--
CILER is a cooperative institute between NOAA and the University of Michigan with formal links to Michigan State University and other universities in the Great Lakes Basin. CILER's research activities are organized around five research themes: climate and large-lake dynamics; coastal and nearshore processes; large-lake ecosystem structure and function; remote sensing of large lake and coastal ocean dynamics; and marine environmental engineering. The Institute supports research scientists, postdoctoral research fellows, research support staff, and students at the University of Michigan and other Great Lakes universities.

Cooperative Institute for Marine and Atmospheric Studies (CIMAS)
Miami, FL--
CIMAS is a cooperative institute between NOAA and the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences. Research is conducted within three themes--Climate Variability, Fisheries Dynamics, and Coastal Ocean Ecosystem Processes--in collaboration with ERL and the National Marine Fisheries Service. CIMAS supports 45 university researchers, postdocs, graduate students, and staff.

Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)
Norman, OK--
CIMMS is a cooperative institute between NOAA and the University of Oklahoma. Research fields include basic convective and mesoscale forecast improvements, and climatic effects of controls on mesoscale processes, socioeconomic effects of mesoscale weather systems and regional scale climate variations. The Institute collaborates with the National Severe Storms Lab, and supports the NWS modernization efforts in Norman. CIMMS supports ~130 university researchers, postdocs, students, and staff.

Cooperative Institute for Research in the Atmosphere (CIRA)
Fort Collins, CO--
CIRA is a cooperative institute between NOAA and Colorado State University. The Institute conducts research involving global and regional climate, local and mesoscale area weather forecasting and evaluation, applied cloud physics, applications of satellite observations, air quality and visibility, societal and economic impacts, numerical modeling, and education, training and outreach. The Institute provides an interdisciplinary forum for research collaboration among university scientists/postdocs/staff/students and several NOAA laboratories and line elements including OAR (the Forecast Systems Laboratory and the Environmental Technology Laboratory, the NWS and the NESDIS (Office of Research Applications, Office of Satellite Development and the Data Centers).

Cooperative Institute for Research in Environmental Sciences (CIRES)
Boulder, CO--
CIRES is a cooperative institute between NOAA and the University of Colorado. The Institute conducts research in environmental chemistry and biology, atmospheric and climate dynamics, cryospheric and polar processes, and the solar-terrestrial environment, and brings together government and university researchers, post docs, and students from eight university departments and several NOAA laboratories in a wide-ranging array of scientific collaborations and interdisciplinary research.

Joint Institute for Marine and Atmospheric Research (JIMAR)
Honolulu, HI--
JIMAR is a cooperative institute between NOAA and the University of Hawaii. Research Foci include equatorial oceanography, climate research, tsunamis, fisheries oceanography , tropical meteorology and

coastal research. In addition to its partnerships with OAR , JIMAR works closely with the Pacific Regions of the National Marine Fisheries Service and the National Weather Service as well as the Coastal Services Center, Honolulu. JIMAR supports 140 university researchers, post doc, students and staff. JIMAR is housed in the University of Hawaii School of Ocean and Earth Sciences and Technology as are two OAR partners; the Hawaii Sea Grant College Program and the Hawaii Undersea Research Laboratory.

Joint Institute for Marine Observations (JIMO)
La Jolla, CA--
JIMO, located on the Scripps La Jolla campus, is a joint institute between NOAA and the University of California's Scripps Institution of Oceanography. JIMO is collocated with the NOAA Southwest Fisheries Center and maintains collaborative programs with several of the NOAA Laboratories across the country, representing a wide range of mutual interests. The overall goal of JIMO is to create a center of excellence in which the state of the art observation capabilities such as platforms (surface, subsea, and air/spaceborne), sensors, and systems architecture of both NOAA and Scripps are utilized to fill pressing research needs. The specific themes reflect the particular strength at Scripps in the areas of coupled ocean-atmosphere climate research, blue water and littoral oceanography, marine biology/biological oceanography, marine geology and geophysics, and ocean technology. It also lends the strength of the Scripps large fleet of surface and subsurface platforms to the success of observation-based science for NOAA.

Joint Institute for the Study of the Atmosphere and Ocean (JISAO)
Seattle, Washington--
JISAO is a cooperative institute between NOAA and the University of Washington and complements the research at PMEL in climate variability, environmental chemistry, estuarine processes and interannual variability of fisheries recruitment. JISAO supports 35 university researchers, postdocs, and students.

## Appendix C

## Deep-ocean Assessment and Reporting of Tsunamis (DART®)

### Background

To ensure early detection of tsunamis and to acquire data critical to real-time forecasts, NOAA has placed Deep-ocean Assessment and Reporting of Tsunami (DART®) stations at sites in regions with a history of generating destructive tsunamis. NOAA completed the original 6-buoy operational array (map of original six stations) in 2001 and expanded to a full network of 39 stations in March, 2008.

Originally developed by NOAA, as part of the U.S. National Tsunami Hazard Mitigation Program (NTHMP), the DART® Project was an effort to maintain and improve the capability for the early detection and real-time reporting of tsunamis in the open ocean. See DART® development for more info.

DART® presently constitutes a critical element of the NOAA Tsunami Program. The Tsunami Program is part of a cooperative effort to save lives and protect property through hazard assessment, warning guidance, mitigation, research capabilities, and international coordination. NOAA's National Weather Service (NWS) is responsible for the overall execution of the Tsunami Program. This includes operation of the U.S. Tsunami Warning Centers (TWC) as well as leadership of the National Tsunami Hazard Mitigation Program. It also includes the acquisition, operations and maintenance of observation systems required in support of tsunami warning such as DART®, local seismic networks, coastal, and coastal flooding detectors. NWS also supports observations and data management through the National Data Buoy Center (NDBC).

### System Overview

DART® systems consist of an anchored seafloor bottom pressure recorder (BPR) and a companion moored surface buoy for real-time communications (Gonzalez et al., 1998). An acoustic link transmits data from the BPR on the seafloor to the surface buoy.

The BPR collects temperature and pressure at 15-second intervals. The pressure values are corrected for temperature effects and the pressure converted to an estimated sea-surface height (height of the ocean surface above the seafloor) by using a constant 670 mm/psia. The system has two data reporting modes, standard and event. The system operates routinely in standard mode, in which four spot values (of the 15-s data) at 15-minute intervals of the estimated sea surface height are reported at scheduled transmission times. When the internal detection software (Mofjeld) identifies an event, the system ceases standard mode reporting and begins event mode transmissions. In event mode, 15-second values are transmitted during the initial few minutes, followed by 1-minute averages. Event mode messages also contain the time of the initial occurrence of the event. The system returns to standard transmission after 4 hours of 1-minute real-time transmissions if no further events are detected.

The first generation DART® (DART I) systems had one-way communications from the BPR to the Tsunami Warning Centers (TWC) and NDBC via the western Geostationary Operational Environmental Satellite (GOES West) (Milburn *et al.*, 1996). DART I became operational in 2003. NDBC replaced all DART I systems with the second generation DART® systems (DART II) in early 2008. DART I transmits standard mode data once an hour (four estimated sea-level height observations at 15-minute intervals). For information about the development of DART® technology, click here.

DART II became operational in 2005 (Green, 2006). A significant capability of DART II is the two-way communications between the BPR and the TWCs/NDBC using the Iridium commercial satellite communications system (Meinig *et al.*, 2005). The two-way communications allow the TWCs to set stations in event mode in anticipation of possible tsunamis or retrieve the high-resolution (15-s intervals) data in one-hour blocks for detailed analysis. DART II systems transmit standard mode data, containing twenty-four estimated sea-level height observations at 15-minute intervals, once very six hours. The two-way communications allow for real-time troubleshooting and diagnostics of the systems. The DART® buoys have two independent and redundant communications systems. NDBC distributes the data from both transmitters under separate transmitter identifiers. NDBC receives the data from the DART II systems, formats the data into bulletins grouped by ocean basin (see the NDBC - DART® GTS Bulletin Transmitter List, for a listing of the bulletin headers used for each transmitted identifier), and then delivers

them to the National Weather Service Telecommunications Gateway (NWSTG) that then distributes the data in real-time to the TWCs via NWS communications and nationally and internationally via the Global Telecommunications System.

**DART® Data Archive**

NOAA's National Geophysical Data Center (NGDC) is the long-term archive center for recovered DART® data, please go to http://www.ngdc.noaa.gov/hazard/DARTData.shtml for more information.

**References**


Gonzalez, F.I., H.M. Milburn, E.N. Bernard and J.C. Newman (1998): Deep-ocean Assessment and Reporting of Tsunamis (DART®): Brief Overview and Status Report. In *Proceedings of the International Workshop on Tsunami Disaster Mitigation,* 19-22 January 1998, Tokyo, Japan.

Green, D. (2006): Transitioning NOAA Moored Buoy Systems From Research to Operations. In *Proceedings of OCEANS'06 MTS/IEEE Conference, 18-21 September 2006*, Boston, MA, CD-ROM.

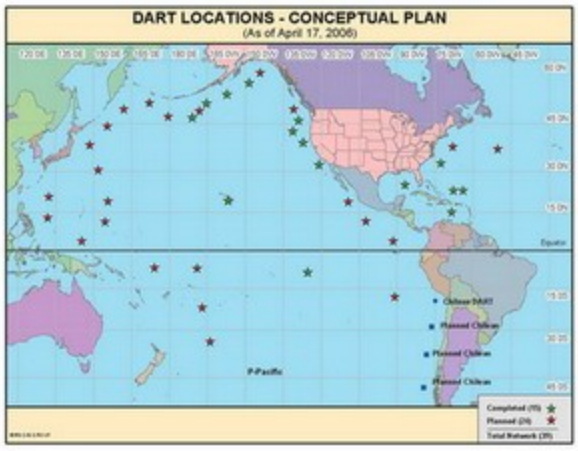
Meinig, C., S.E. Stalin, A.I. Nakamura, H.B. Milburn (2005), Real-Time Deep-Ocean Tsunami Measuring, Monitoring, and Reporting System: The NOAA DART II Description and Disclosure.

Milburn, H.B., A.I. Nakamura, and F.I. Gonzalez (1996): Real-time tsunami reporting from the deep ocean. *Proceedings of the Oceans 96 MTS/IEEE Conference,* 23-26 September 1996, Fort Lauderdale, FL, 390-394.

Mofjeld, H.O., Tsunami Detection Algorithm


**About DART® tsunami monitoring buoys**

How the DART® Network helps forecasting: The information collected by a network of DART® systems positioned at strategic locations throughout the ocean plays a critical role in tsunami forecasting. The map at right shows the conceptual plan for DART® locations published in the NOAA magazine, Apr 17, 2006.




When a tsunami event occurs, the first information available about the source of the tsunami is based only on the available seismic information for the earthquake event. As the tsunami wave propagates across the ocean and successively reaches the DART® systems, these systems report sea level information measurements back to the Tsunami Warning Centers, where the information is processed to produce a new and more refined estimate of the tsunami source. The result is an increasingly accurate forecast of the tsunami that can be used to issue watches, warnings or evacuations.

**DART® buoy development:**

Over the past 20 years, NOAA's Pacific Marine Environmental Laboratory (PMEL) has identified the requirements of the tsunami measurement system through evolution in both technoloy and knowledge of deep ocean tsunami dynamics. The tsunami forecasting technology developed at PMEL is based on the integration of realtime measurements and modeling technologies, a well-tested approach used in most hazard forecast systems.

The first-generation DART® design featured an automatic detection and reporting algorithm triggered by a threshold wave-height value. The DART® II design incorporated two-way communications that enables tsunami data transmission on demand, independenty of the automatic algorithm; this capability ensures

the measurement and reporting of tsunamis with amplitude below the auto-reporting threshold. The next generation DART® ETD (Easy To Deploy) buoy is presently under development at PMEL.

Developed by PMEL and deployed operationally by NOAA's National Data Buoy Center (NDBC), DART® is essential to fulfilling NOAA's national responsibility for tsunami hazard mitigation and warnings.

## Appendix C

## NOAA Research Scientific Computing Support Investments
## PPBES Quarterly Quad Charts – Climate, Ecosystem and Weather&Water

***Quarter 1 – FY2008 – No Quad Charts available due to Continuing Resolution***

***Quarter 2 - FY2008***

### OAR Research for Climate Chart as of 2nd Quarter 2008

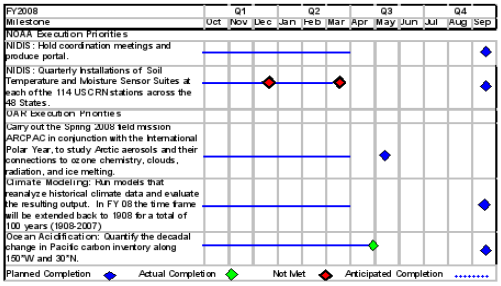
**G** **Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)**

| Measure | 2nd Q planned | 2nd Q actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| GPRA: U.S. Temperature Forecasts | 19 | 28 | 28 / 19 |
| GPRA: Reduce uncertainty in North American carbon uptake | NA* | NA* | 0.35 GT/yr |
| GPRA: Explained variance (%) for US temperature and precipitation | 97.7/94.6 | 97.9/94.8 | 98.0/95.0 |
| GPRA Reduce uncertainty in model simulations of the influence of aerosols on climate | NA* | NA* | 15% |
| GPRA: Reduce error in measurement of global SST | NA** | 0.40 | 0.5 |
| GPRA: Improve society's ability to plan and respond to climate variability | 10 | 12 | 12 / 35 |

* These performance measures can only be measured on an annual basis.
**No target can be developed on a quarterly basis.

**Y** **Schedule (FY 2008)**

Q2 Milestones Planned = 1 | Q2 Milestones Met = 0




**Y** **Key Issues/Risks**

**Issue:**
- NIDIS Soil Temperature and Moisture Sensor Suite installation funding not received in FY 2008 prior to onset of cold weather. Twenty sites were anticipated by end of FY 2008, however none will be installed this year.

**Risk:**
- In FY 2008, lack of deployments could impact planned pilot studies.

**Mitigation:**
- $1.15 Million plus up in FY 2008 will enable project to attain goals early in FY 2009. 60 sites (600 sensor) expected to be installed by end of FY 2009 rather than previous schedule of 20 sites in FY 2008 and 40 in FY 2009.

**Issue:**
- AMOC funding not anticipated for FY 2008, therefore no milestones were established. However, future milestones were incorporated in the NOAA 5 Year Research Plan.

**Mitigation:**
- AMOC received unplanned initial funding of $250,000 for FY2008 and expects to be funded at full level for FY 2009.

**G** **Budget/Funding (FY 2008)**

### OAR Research for Ecosystems Quad Chart as of 2nd Quarter 2008

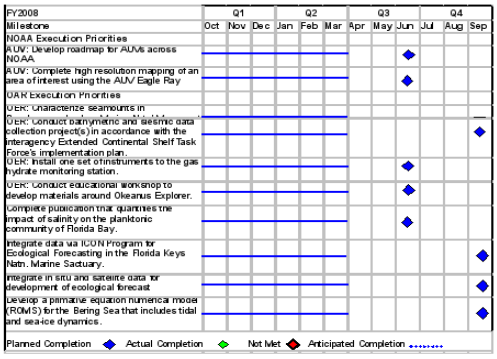
**G** **Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)**

| Measure | 2nd Q planned | 2nd Q actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| GPRA: Annual number of coastal, marine, and Great Lakes ecosystems sites adequately characterized for management | 3 | 3 | 4 / 43* |
| GPRA: Cumulative number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management. | 0 | 0 | 35 / 38 |
| GPRA: Number of tools, technologies, and information services that are used by NOAA partners/customers to improve ecosystem-based management. | 0 | 0 | 1 / 42* |

* Accomplishment of milestones associated with these performance measures have been weighted to the end of the FY due to funding restrictions in place under continuing budget resolutions.

**G** **Schedule (FY 2008)**

Q2 Milestones Planned = 0 | Q2 Milestones Met = 0




**G** **Key Issues/Risks**

**G** **Budget/Funding (FY 2008)**

## OAR Research for Weather & Water Quad Chart as of 2nd Quarter 2008

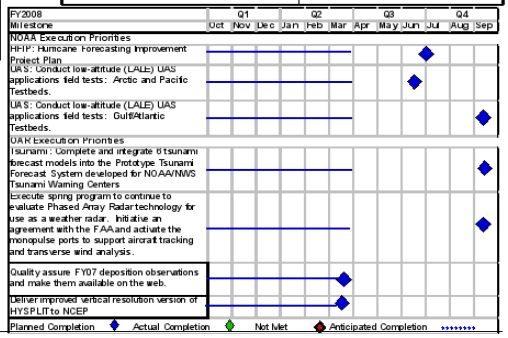
**Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)***

| Measure | 2nd Q Planned | 2nd Q Actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| Non-GPRA: Efficiency in collecting wet deposition observations | 1 | 1 | 1/1 |

* Performance measures for ST&I are currently being modified.

**Schedule (FY 2008)**

Q2 Milestones Planned = 2 | Q2 Milestones Met = 2




**Key Issues/Risks**

**Issue:**
- ARL reimbursable contract with EPA expires in December 2008.

**Risk**
- Insufficient resources to continue air quality forecasting.

**Mitigation:**
- OAR plan to relocate capability and staff to NWCFC to continue this work.

**Budget/Funding (FY 2008)**

***Quarter 3 – FY2008***

## OAR Research for Climate Chart as of 3rd Quarter 2008

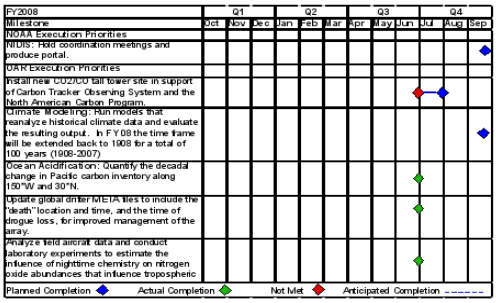
**Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)**

| Measure | 3rd Q planned | 3rd Q actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| GPRA: U.S. Temperature Forecasts | 19 | 25.2 | 25.2 / 19 |
| GPRA: Reduce uncertainty in North American carbon uptake | NA* | NA* | 0.35 PgC/yr |
| GPRA: Explained variance (%) for US temperature and precipitation | 97.9/94.8 | 98.04/95.1 | 98.04/95.1 |
| GPRA: Reduce uncertainty in model simulations of the influence of aerosols on climate | NA* | NA* | 15% |
| GPRA: Reduce error in measurement of global SST | NA** | 0.496 | 0.496/0.50 |
| GPRA: Improve society's ability to plan and respond to climate variability | NA | NA | 12 / 35 |

* These performance measures can only be measured on an annual basis.
**No target can be developed on a quarterly basis.

**Schedule (FY 2008)**

Q3 Milestones Planned = 5 | Q3 Milestones Met = 3




**Key Issues/Risks**

**Issue:** Installation of new CO2/CO tall tower delayed one month due to procurement problems with partner agency (DOE) for concrete foundation for sea container and electrical work.

**Risk:** No risk to overall carbon tracker project.

**Mitigation:** NOAA staff solved the concrete issue by taking over concrete installation. Construction is now in progress with completion projected for the end of July.

**Budget/Funding (FY 2008)**

## OAR Research for Ecosystems Quad Chart as of 3rd Quarter 2008

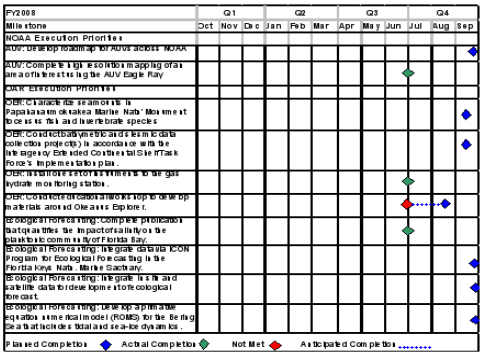
**Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)**

| Measure | 3rd Q planned | 3rd Q actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| GPRA: Annual number of coastal, marine, and Great Lakes ecosystems sites adequately characterized for management | 4 | 4 | 8 / 43* |
| GPRA: Cumulative number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management. | 35 | 35 | 35 / 38 |
| GPRA: Percentage of tools, technologies, and information services that are used by NOAA partners/customers to improve ecosystem-based management. | 85% | 85% | 86% |

* Accomplishment of milestones associated with these performance measures have been weighted to the end of the FY due to funding restrictions in place under continuing budget resolutions.

**Schedule (FY 2008)**

Q3 Milestones Planned = 4 | Q3 Milestones Met = 3




**Key Issues/Risks**

**Issue:** Delayed Okeanos Educational Workshop to accommodate participants' schedules.

**Risk**: Future success was improved by delaying workshop to enable better participation.

**Budget/Funding (FY 2008)**

## OAR Research for Weather & Water Quad Chart as of 3rd Quarter 2008

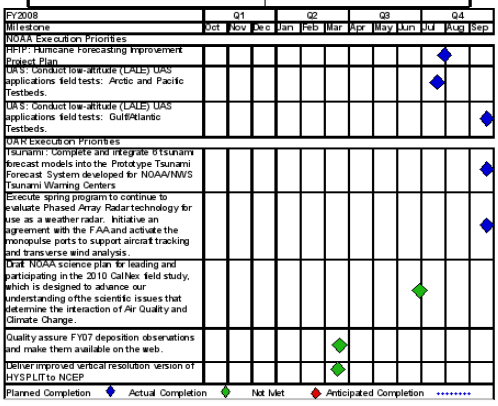
**Corporate Performance Measures (GPRA & non-GPRA) (or other relevant measures)***

| Measure | 3rd Q Planned | 3rd Q Actual | Total to Date/ FY 08 Target |
|---|---|---|---|
| Non-GPRA: Efficiency in collecting wet deposition observations | 1 | 1 | 1/ 1 |

* Performance measures for ST&I are currently being modified.

**Schedule (FY 2008)**

Q3 Milestones Planned = 1 | Q3 Milestones Met = 1




**Key Issues/Risks**

**Issue:** ARL reimbursable agreements with EPA expire in September 2008.

**Risk**: Insufficient resources to continue research for improvement in air quality forecasting.

**Mitigation**: EPA is accepting reassignment of 43 FTE. OAR still needs to place a GS-14 meteorologist. Program plans and budget narratives are in place to support reconstituting air quality forecasting research and development capability at ARL, eventually to be co-located with NCEP in FY09.

**Budget/Funding (FY 2008)**

***Quarter 4 – FY2008***

## OAR Research for Climate Chart as of 4th Quarter 2008

**Relevant Performance Measures** — G

| Measure | 4th Q planned | 4th Q actual | FY 08 Target | FY 08 Met |
|---|---|---|---|---|
| GPRA: U.S. Temperature Forecasts | 19 | 25.6 | 19 | 25.6* |
| GPRA: Reduce uncertainty in North American carbon uptake | NA* | NA* | +/-0.4 Gt Carbon/yr | +/-0.4 Gt Carbon/yr ** |
| GPRA: Explained variance (%) for US temperature/precipitation | 98.0/95.0 | 98.3/ 95.1 | 98.0/95.0 | 98.3/95.1 |
| GPRA: Reduce uncertainty in model simulations of the influence of aerosols on climate | NA | NA | 15% | 15%*** |
| GPRA: Reduce error in measurement of global SST | NA | 0.52 | 0.50 | 0.50 |
| GPRA: Improve society's ability to plan and respond to climate variability using products and information (# of studies) | 25 | 25 | 37 | 37 |

*Exceeded target.
**The results for this measure are estimated because performance can only be measured on an annual basis. Actual results of FY08 data calculations expected March 2009.
***The results for this measure are estimated because the measurements were delayed until December 2008 due to funding delays.

**Schedule (FY 2008)** — G

Q4 Milestones Planned = 8 | Q4 Milestones Met = 8

| FY2008 | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milestone | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| NOAA Execution Priorities | | | | | | | | | | | | |
| NIDIS: Hold coordination meetings and produce portal. | | | | | | | | | | | | ◆ |
| NIDIS: Develop framework for product development to support climate literacy standards | | | | | | | | | | | | ◆ |
| OAR Execution Priorities | | | | | | | | | | | | |
| CSD: Install new 2009 Corvall tower site in support of Carbon Tracker Observing System and the North American Carbon Program. | | | | | | | | | | ◆ | ◆ | |
| CRM: Run models that reanalyze historical climate data and evaluate the resulting output. In FY 08 the time frame will be extended back to 1908 for a total of 100 years (1908-2007) | | | | | | | | | | | | ◆ |
| CSD: Establish one new RISA | | | | | | | | | | | | ◆ |
| COM: Deploy ATLAS moorings in RAMA (Indian Ocean) at 2 new sites. | | | | | | | | | | | | ◆ |
| COM: Increase Per Cent (%) of variables reported each year(ECV)to be added to the measurements of glaciers and ice sheets. | | | | | | | | | | | | ◆ |
| COM: Increase number of CDRs developed, tested and validated in 2008 for coud data. | | | | | | | | | | | | ◆ |
| COM: Update the NOAA Annual Greenhouse Gas Index (AGGI) | | | | | | | | | | | | ◆ |

◆ Planned Completion ◆ Actual Completion Not Met

**Key Issues/Risks** — G

**Budget/Funding (FY 2008)** — G

## OAR Research for Ecosystems Quad Chart as of 4th Quarter 2008

G

**Relevant Performance Measures**

| Measure | 4th Q planned | 4th Q actual | FY 08 Target/Met |
|---|---|---|---|
| **GPRA**: Annual number of coastal, marine, and Great Lakes ecosystems sites adequately characterized for management | 35 | 35 | 43/43 |
| **GPRA**: Cumulative number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management. | 3 | 3 | 38/38* |
| **GPRA**: Percentage of tools, technologies, and information services that are used by NOAA partners/customers to improve ecosystem-based management. | 86% | 86% | 86%/86% |

**Schedule (FY 2008)** — Y

Q4 Milestones Planned = 9 | Q4 Milestones Met = 8

| FY2008 | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milestone | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| NOAA Execution Priorities | | | | | | | | | | | | |
| AUV: Develop roadmap for AUVs across NOAA | | | | | | | | | | | | ◆ |
| OAR Execution Priorities | | | | | | | | | | | | |
| OER: Characterize seamounts in Papahanaumokuakea Marine Nat'l Monument to focus on fish and invertebrate species | | | | | | | | | | | | ◆ |
| OER: Conduct baseline physical and chemical data collection project(s) in accordance with the Interagency Extended Continental Shelf Task Force's implementation plan. | | | | | | | | | | | | ◆ |
| OER: Conduct critical path analysis/ops to develop materials around Okeanos Explorer. | | | | | | | | | | ◆ | ◆ | |
| Ecological Forecasting: Integrate data into ICON Program for Ecological Forecasting in the Florida Keys Nat'l Marine Sanctuary. | | | | | | | | | | | | ◆ |
| Ecological Forecasting: Integrate in situ and satellite data for development of ecological forecast. | | | | | | | | | | | | ◆ |
| Ecological Forecasting: Develop application of operational numerical model (ROMS) for the Bering Sea that includes tidal and sea ice dynamics. | | | | | | | | | | | | ◆ |
| Outreach and Education: Develop an OER East Coast ROV plan with locations and exploration of the continental slope from N. Atlantic. | | | | | | | | | | | | ◆ |
| Ecosystem Condition: Complete seasonality analysis on the importance of physical processes on Great Lakes sediment. | | | | | | | | | | | | ◆ |
| Ecosystem Condition: Complete programming and uncertainty analyses for Chesapeake Bay physical/sea model. | | | | | | | | | | | | ◆ |

◆ Planned Completion ◆ Actual Completion Not Met

Y

**Key Issues/Risks**

**Issue**: Primary duties of several AUV working group members have increased, leaving less time to devote to AUV roadmap development.

**Risk**: The delay of completion of an AUV roadmap leaves NOAA's coordination of AUV activities incomplete.

**Mitigation**: Increased staffing could be considered. Alternatively, NOAA has increased coordination with Navy enabling utilization of test range and vehicle use in Panama City, FL; and Newport, RI.

**Budget/Funding (FY 2008)** — G

# OAR Research for Weather & Water Quad Chart as of 4th Quarter 2008

## Relevant Performance Measures

G

| Measure | 4th Q Planned | 4th Q Actual | FY 08 Target/Met |
|---|---|---|---|
| **Non-GPRA**: Efficiency in collecting wet deposition observations | 0 | 0 | 1/1 |

## Schedule (FY 2008)

G

Q4 Milestones Planned = 10 | Q4 Milestones Met = 9

| FY2008 | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milestone | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| NOAA Execution Priorities | | | | | | | | | | | | |
| HFIP: Hurricane Forecasting Improvement Project Plan Completed. | | | | | | | | | | ◆ | | |
| HFIP: Improved realtime QC processing of airborne Doppler from FY07 & FY08 tests. | | | | | | | | | | | | ◆ |
| HFIP: Publish paper describing HWRF model sensitivity studies of physical processes at higher horizontal grid resolutions | | | | | | | | | | | | ◆ |
| UAS: 2 milestones completed. Conducted low-altitude (LALE) UAS applications field tests. | | | | | | | | | | | | ◆ |
| OAR Execution Priorities | | | | | | | | | | | | |
| Tsunami: 2 milestones completed: Integrated 6 forecast models into the Prototype Tsunami Forecast System and implemented SIFT 2.0 | | | | | | | | | | | | ◆ |
| Air Quality: Completed field studies related to wintertime particulate matter formation. | | | | | | | | | | | | ◆ |
| Severe Weather: Evaluate new flash flood guidance values for monitoring and prediction. | | | | | | | | | | | | ◆ |
| MPAR: Evaluated Phased Array Radar technology during Spring Program. Initiated MOU with the FAA and activated the monopulse ports to support aircraft tracking and transverse wind analysis. | | | | | | | | | | | | ◆ |

Planned Completion ◆ Actual Completion ◆ Not Met ◆

## Key Issues/Risks

G

**Issue:** Evaluation of new approaches in deriving gridded flash flood guidance values for monitoring and prediction did not meet its deadline because there were insufficient flash floods in time to complete the projects. The flash floods that were monitored were later in the season than expected and therefore require additional time to complete the evaluation.

**Risk**: No risks expected.

**Mitigation**:. The evaluation will be completed in the next few months.

## Budget/Funding (FY 2008)

G